THE TECH ENGINEERING NEWS

MEMBER OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

MASSACHUSETTS
INSTITUTE OF
TECHNOLOGY

VOLUME X, NO. 6
NOVEMBER, 1929

A NEW DESIGN

BOX-HEADER BOILER

The new C-E Single-Seam Box-Header Boiler is a distinct advance in construction and design over ordinary box header practice.

In the new design —

The wrapper or butt strap joining the tube and hand hole sheets is —ELIMINATED.

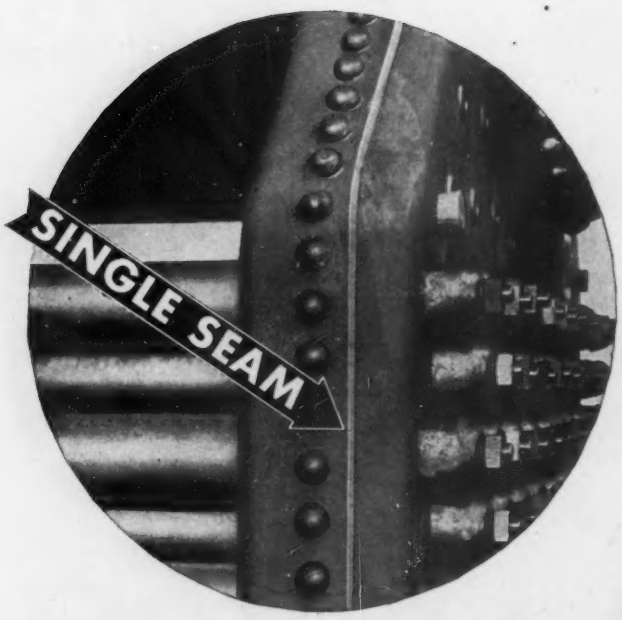
ONE ROW OF RIVETS JOINS THE TUBE SHEET DIRECTLY TO THE HAND HOLE SHEET.

The row of rivets on the tube side of the wrapper strap is —ELIMINATED.

THERE IS ONLY ONE CAULKING EDGE and this faces the outside — making inspection easy and removing all rivets out of the hot gas and fire zones.

Three thicknesses of metal at the caulking joint at the ears are — REDUCED TO TWO THICKNESSES.

This new design provides an unusual factor of safety. For instance, in the standard unit sold for 160 lb. to 250 lb. working pressure, the header joint is adequate for a working pressure of 450 lb.



A careful inspection of this new boiler will convince you that the C-E Box-Header Boiler is a better Box-Header Boiler.

COMBUSTION ENGINEERING CORPORATION

International Combustion Building
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A Subsidiary of
International Combustion Engineering Corporation

Koehring-Mixed Foundation
for Federal Building

Probably one of the most interesting and attractive of the federal buildings erected during the last year is the United States Post Office and Court House at Madison, Wisconsin. In addition it is one of the first in the building program resumed since the World War.

Situated in the shadow of the state capitol and only a few hundred feet from Lake Monona, one of the four lakes which surround Madison, the three-story building of Bedford stone has an ideal setting.

Employing the latest methods in the interior transfer of mails the Post Office department arranged the rooms, conveying machinery and platforms to bring about greater ease and speed in the handling of all classes of mail.

In the main lobby, marble slabs cover the walls from the floor to a height of eight feet. Quarter-sawed oak is the interior finish throughout the building.

Despite other unique features found in the Madison Post Office, its foundation of dominant strength concrete is similar to that of other well-known building projects throughout the world — concrete mixed by a Koehring.

The ingredients of concrete are the same in all cases but the Koehring re-mixing action — a fundamental principle of Koehring concrete mixers and pavers — coats every particle of sand and gravel with cement to produce dominant strength concrete.

"Concrete—Its Manufacture and Use," a complete treatise and handbook on present methods of preparing and handling portland cement concrete, will be gladly sent on request to engineering students, faculty members and others interested.

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Pavers, Mixers—Gasoline Shovels, Pull Shovels, Cranes and Draglines
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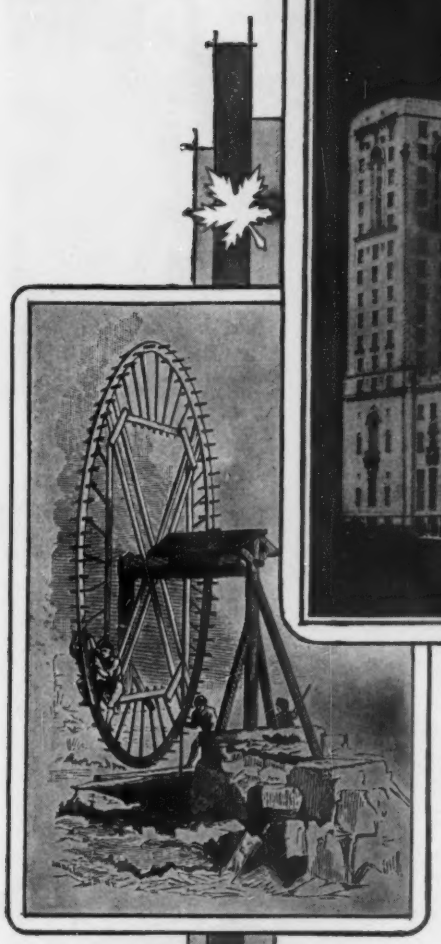
THE ROYAL YORK HOTEL, TORONTO, CANADA

Ross & MacDonald, Architects *Sproat & Rolph, Associate Architects*



Reproduction of an old wood-cut showing one of the early phases of Vertical Transportation

The Tallest Building in the British Empire

THE new Royal York Hotel, Toronto, Canada, is the British Empire's tallest building and its largest hotel. This immense structure embodies modern improvements throughout and particularly in regard to Vertical Transportation, which is provided by seventeen elevators of Otis-Fensom manufacture. Ten of these are Otis Signal Control elevators, and the remainder are equipped with Otis "Flying Stop" control.

Here again is found proof of the saying that "most of the world's famous buildings are Otis-equipped."

OTIS ELEVATOR COMPANY

OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

WHAT YOUNGER COLLEGE MEN ARE DOING WITH WESTINGHOUSE

This 5000 h.p. motor in the Columbia Steel Company's Plant, with its frame of arc-welded steel, is physically the largest synchronous motor ever built.

H. R. HILLMAN
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Carnegie Institute of Technology, '22

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Switchboard Engineer
Syracuse University, '22

H. C. MEYERS
Machine Design
University of Nebraska, '27

H. G. DILLON
Production Supervisor
Oklahoma A & M College, '23

Ninety days to go— teamwork wins

While you Seniors were shuffling worries about machine stresses and saturation curves with those of football last fall, a group of your predecessors, not so many years ahead of you, were playing the game with grim realities.

The Columbia Steel Company of Pittsburg, California, completed plans on September 12th to build a new tinplate plant. On the 13th they gave an order to Westinghouse for two 5,000 horsepower synchronous motors to drive the rolls, to be physically the largest synchronous motors ever built. Delivery of the first was wanted in ninety days.

Ninety days in which to design, manufacture, assemble, test and ship any large unit, let alone a new achievement in size and type of construction, affords no time for idle speculation. Westinghouse men went at the job as only an experienced and thoroughly equipped organization could do. And on the scheduled date, four flat cars and a box car rolled out of the Westinghouse plant, carrying the completed and tested motor.

It was an industrial victory, as satisfying as any athletic gain. Teamwork and individual skill had won. Westinghouse had once more made good and upheld the reputation that earns the big electrical jobs for Westinghouse men.

Westinghouse

With a mighty surge Industry rolls on... and modern production rolls on Timken—*the one bearing that does all things well.*

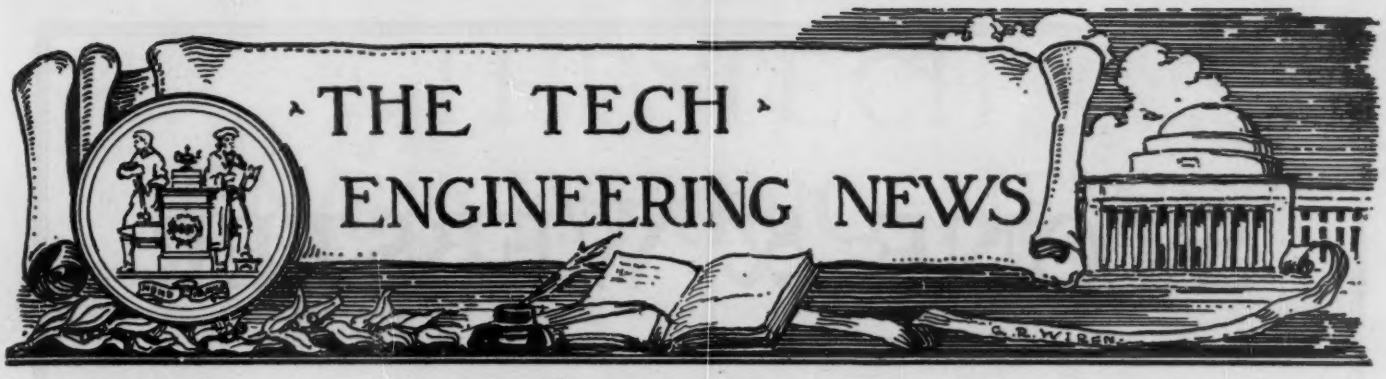
Timken ability and versatility are destined to play a more and more important part in the future life of the nation, and student engineers will find it well worth while to make a close study of the present applications and possibilities of Timken Bearing Equipped—wherever wheels and shafts turn.

Whether the loads be all *radial,* all *thrust, or both in combination,* Timken Bearings —with their exclusive Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken steel—can be entrusted with the peak of the production load of the world.

Industry, Agriculture, Transportation, Mining feel the mighty momentum of modern methods... replacing the obsolete with "Timken Bearing Equipped"... stepping up the speed... defeating deadly friction ... beating down high costs... slashing maintenance... placing lubrication at an irreducible minimum... setting depreciation at defiance.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**



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THE TECH ENGINEERING NEWS

THE PROFESSIONAL JOURNAL OF THE UNDERGRADUATES OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

VOLUME X NOVEMBER, 1929 NUMBER 6

CULTURAL TRAINING FOR ENGINEERS

An M.I.T. professor points out cultural opportunities for Technology students

By WILLIAM EMERSON
Professor of Architecture
Head of the Department of Architecture
Massachusetts Institute of Technology

BEFORE pointing out what Technology has to offer its students in the field of culture, or even what cultural opportunities outside of Technology may be within the reach of our students in and near Boston, it would seem pertinent to indicate why and how cultural courses have come to be essential in an engineer's education.

President Rogers certainly had such an ideal before him in founding the Massachusetts Institute of Technology which he believed should endeavor "to furnish such a general education . . . as shall form a fitting preparation for any of the departments of active life." Thus an education limited to the strictly technical would not have met his requirement. To be general an education must be broad, must touch many fields other than those in which the student means to specialize. "Culture," according to Matthew Arnold, "is the acquainting ourselves with the best that has been known and said in the world, and thus with the history of the human spirit." Such an acquaintance results in refinement and enlightenment, in a broad sense, in civilization. Thus cultural training is a step in the process of civilization.

It is all but impossible to conceive of civilization except as a result of education, and while there has been a long-standing general belief in the value of cultural subjects in engineering curricula, the essential need of such subjects is more generally recognized now than at any time in the past sixty years. Professor Melville Enger, of the University of Illinois, speaks convincingly in this connection when he says, "It must be admitted that the curricula of engineering schools should include courses outside of the engineering field to keep them from being too one-sided. Non-technical courses having no direct relation to the student's specialty are the most valuable because it is important to broaden his range of interest."

Accepting the value to the engineer of a cultural training, let us see what Technology does to help him to acquire it. No more immediate application of the advice last quoted could be found than exists in our General Studies. The wording of the purpose of these courses is in itself significant and a true indication of the ideal which brought this group of courses into existence: "This division includes those subjects of a general and essentially non-vocational character which are offered for the purpose of giving the student an opportunity to broaden his education. They are designed to introduce him to fields of thought and interests outside of his chosen professional field."

Assuming that these courses tend toward a cultural equipment for an engineer, however inadequately, it will, I think, be of interest to see what subjects are included in this list, and what fields they represent. It may not be inappropriate here to point out that the recent revision of the list of General Studies was an attempt to eliminate a large number of technical or semi-technical subjects that seemed to be contrary to the fundamental animating spirit of the group, and though there are consequently fewer courses than before, their value for their particular purpose can hardly be questioned.

These subjects included under General Studies are divided into four main groups. In the first, topics of social, political or economic interest are offered, very inadequately covering the possibilities of these three great fields, but still sufficiently suggestive to serve as an introduction at least. The second group, pertaining to Science, while also much too restricted in numbers, is rich in cultural interest, and touches perhaps resources of greater culture than any one of the four.

We should be glad to see included in the third group similar courses in Spanish, Italian or German, to those already available in French, but this is at present beyond our facilities. Fuller justice is given to English literature and history in the fourth group than to any other subjects offered. Here we also find excellent courses on the fine arts, drama and music, that serve as a much needed balance and recreation for those of us whose time is largely spent on what is more strictly technical.

This group is the present expression of what another of Technology's presidents felt was a desirable tendency when President Walker said in 1891: "Doubtless the present general scheme

(Continued on page 246)

Military Mechanization

Some phases of the enormous development in ordnance that has taken place since the World War

By MAJ. RICHARD H. SOMERS, U. S. A.
Assistant Professor of Military Science and Tactics
In Charge of Ordnance Unit
Massachusetts Institute of Technology

THE term "mechanization," when used in connection with things military, and particularly when used in connection with the probable future of warfare, is much in the public eye and the public ear at the present time. Not only is it attracting a great deal of attention in professional military circles, but it is being much discussed by thoughtful people everywhere. The World War has made it clearly apparent that warfare in the future must involve the use of every resource of a nation in the manner most effective toward securing the end sought. Among other things, this involves the utmost practicable use of machines to supplement and make more effective the work of the soldier.

In the mind of the user the word "mechanization" frequently appears to refer to the use of some particular type or class of the machinery of war. For instance, he may have in mind the application of gasoline power to vehicles to replace the horse and give the troops greater mobility. But in all its generality the term should be understood as applying to every phase of mechanical development for military purposes. It is perhaps best defined by General C. C. Williams, Chief of Ordnance, United States Army, when he says:

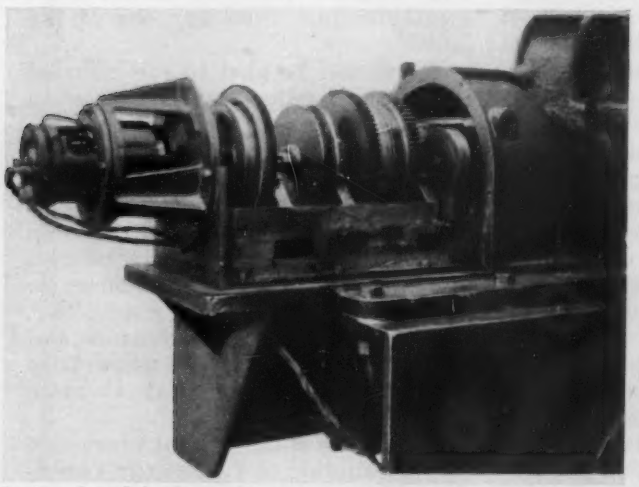
"By mechanization is meant those means and methods by which the tremendous mechanical developments of the age are brought to the assistance of our soldiers on the battlefield."

It is beyond the scope of the present article to discuss mechanization in the broadest sense of the term. It is desired merely to point out some of the recent mechanical developments along Ordnance lines which are fairly indicative of the kind of problem which now confronts the military engineer, to discuss some of the factors which influence and limit the solution of these problems and, most important, to suggest the imperative necessity which exists and which will continue to exist, in peace and in war, for the work of the professional military engineer, to be supplemented by the coöperation and assistance of his civilian colleague.

The development of the application of the internal combustion engine to battlefield transportation is, naturally, a very active one, paralleling more or less closely the correspondingly active commercial development of cargo carrying and pleasure vehicles. Every commercial development offers, of course, opportunity to the military engineer. It remains for him, by adapting these developments to military needs and supplementing them by new developments of his own, to bring out those types of vehicles which will best meet the needs of the military service.

Outside factors impose definite limitations upon the military as well as upon the commercial engineer. The rapid development of a widespread network of hard-surfaced roads throughout the United States, the raising of the standards of width and clearance and the increasing capacity for load carrying of highway bridges may lead to the impression that the size and power of such military vehicles as tanks and self-propelled gun mounts may be increased indefinitely. Such, however, is decidedly not the case. A "land-battleship" is not likely to appear either in the near or the remote future. The very permanence of recent highway construction is a factor telling against vehicular construction of a size beyond the capacity of the existing highway system. Moreover, military vehicles must be developed to meet, not the best existing road conditions as to permissible load and clearances, but conditions approximating those under which service may be required off the hard-surfaced road system either at home or elsewhere. There seems to be, therefore, a fairly definite upper limit to the size to which military automotive vehicles may be developed. Certainly the immense engines of war, sometimes pictured in the popular press as rolling over large cities, leaving death and destruction in their wake, must remain figments of an uncontrolled imagination.

A factor which assumes major importance as soon as the hard-surfaced roads are left behind is that of the bearing pressure between the wheels (or caterpillar treads) and the ground. Any given weight may be supported upon ground of a given condition provided that this weight may be distributed over a sufficient area to bring the



Courtesy *Army Ordnance*

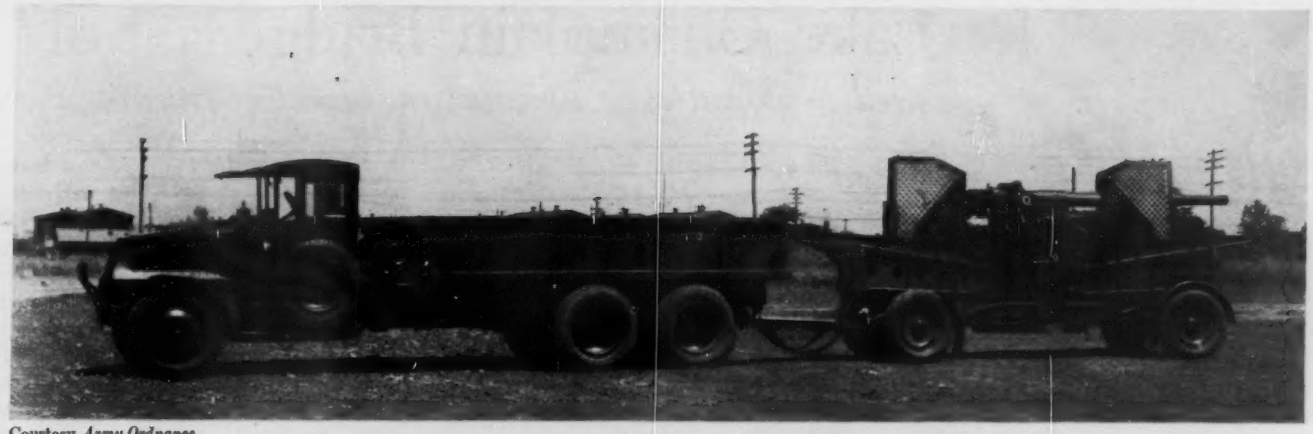
TORQUE AMPLIFIER

This device will eventually supersede the gunner on the data receiver. It keeps the gun properly trained without human intervention between the director and the gun.

Courtesy *Army Ordnance*

DATA RECEIVER FOR ANTI-AIRCRAFT GUNS

The electrically controlled pointer is moved automatically from the director. In keeping the mechanically controlled pointer opposite the electrically controlled one, the gunner keeps the gun trained on the target. He has no scale to read.



Courtesy *Army Ordnance*

MOBILE THREE-INCH ANTI-AIRCRAFT GUN
It is being towed by a commercial six-wheel truck.

pressure per square inch within that which the ground is capable of sustaining. This is as true of a moving load as of a static one such as that of a building. For a given vehicle the solution must be a practical one rather than a strictly mathematical one. There must be some limiting pressure below which it is not worth while to construct the vehicle to go. This will vary, naturally, with the vehicle. For vehicles of the cross-country type it may be as low as six and one-half pounds per square inch.

Bearing surface may be increased by increasing the size of tires; by using a greater number of tires per axle — double wheels; by using two rear axles, properly articulated, instead of one; by placing caterpillar treads upon the wheels in somewhat the manner that chains are used in slippery weather; or by the use of a caterpillar tread on a vehicle of the track-laying type. All of the above means are in more or less current commercial use. This use is encouraged and stimulated by the Army, which is actively prosecuting developments along the same lines.

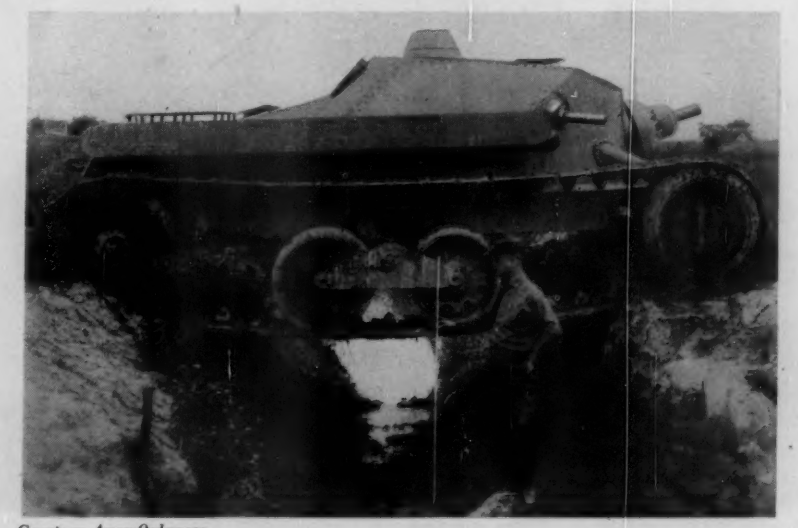
Every attempt to decrease the bearing pressure, however, results at the same time in greater weight and cost and increased complexity in the chassis. In the case of the track-laying vehicles, the wear and tear in service is excessive. There are many joints and bearing surfaces, much dirt and grit is picked up in operation and the matter of upkeep is a serious one. Progress is being made, however, in overcoming the most serious difficulties. The wartime tank, for instance, required a major overhaul after from fifty to sixty miles of operation. The recent Army light tank has operated over a distance of two thousand miles without major overhaul.

Vehicles of the track-laying type are not adapted to running over hard-surfaced roads. They are essentially soft ground vehicles and to use them over hard surfaces at high speeds increases the wear and tear enormously. The Christie tank attempts to combine the features of a track-laying vehicle on soft ground with those of a wheeled vehicle on hard roads. This is done by means of flexible tracks or belts running over the front and rear wheels on either side, in conjunction with intermediate wheels which may be brought into bearing between the front and rear wheels. With the tracks in place, the vehicle is a track-layer with correspondingly low ground pressure; with the tracks removed, it can operate as a high-speed wheeled vehicle.

The Christie principle of universality has been carried further in the construction of an "amphibian" gun mount, into which is built a waterproof body or boat, so that it may operate as a wheeled vehicle on hard roads, become transformed into a track-layer when the going becomes softer and then into a self-propelled boat when water is to be crossed.

Another highly important factor which must govern the military automotive engineer is what may be designated as "procurability." It is not sufficient that satisfactory types of vehicles be designed, developed and tested for war use. In time of war these types must quickly become available in enormous numbers. To build a sufficient number in time of peace and hold them in store until needed in war involves two serious drawbacks. In the first place, the cost of such a store would run into hundreds of millions of dollars — certainly far beyond any amount which Congress could reasonably be expected to make available for the purpose. In the second place, the rapid rate of development in automotive and metallurgical lines would soon render such a store obsolete. The solution here necessarily lies in the diligent prosecution of development, thus keeping abreast of the best, and in making use to the greatest practicable extent in time of emergency, of vehicles currently in commercial production — either in their en-

(*Continued on page 236*)



Courtesy *Army Ordnance*

THE CHRISTIE TANK
This machine has caterpillar tracks installed over rubber-tired wheels. The tracks may be quickly removed, adapting the tank to rapid travel over smooth roads.

The Lake Champlain Bridge

New methods are used to obtain some unusual engineering features

By CHARLES M. SPOFFORD '93
Hayward Professor of Civil Engineering, Head of the Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology

THE growth of motor traffic in the United States has resulted in the construction of numerous toll bridges, generally built by private capital but occasionally by public bodies. The recently constructed bridge across Lake Champlain between the states of New York and Vermont furnishes an example of the latter type. This bridge was financed, built and owned by a public commission set up by the two states of New York and Vermont, under authority of Congress, and having full power over the particular project entrusted to it. The total cost of the bridge, including not only the cost of its construction and the real estate for its approaches, but also the administration, legal and engineering expenses was somewhat less than $1,200,000 of which $1,000,000 was raised by the sale of thirty-year bonds bearing 4¼ per cent interest. The income from tolls is to be used in liquidating the cost of the bridge so that it may be made free as soon as feasible. All estimates show that the income from tolls should be sufficient to meet the requirements of the bond issue long before the bonds mature. These estimates are confirmed in some degree by the fact that in the eight weeks after the opening of the bridge, ending October 22, the receipts from tolls were approximately $25,000.

Had it been necessary for the two states to appropriate funds to pay for the bridge outright, without any prospect of obtaining revenue therefrom, the building of this bridge would probably have been long deferred.

The new bridge is the only bridge crossing Lake Champlain in a length of 120 miles, a portion of the lake which has ever constituted a serious barrier to intercourse between the states of New York and Vermont. In times of open water, transportation for vehicles across the lake has been available, to a limited extent, by ferries, but most of these were operated only by day, some of them had hazardous approaches, and, in some cases, they were not operated during bad weather. In winter, occasional roads have existed across the ice.

The bridge is located at the site of one of the ferries which has discontinued service. It will doubtless reduce traffic on other nearby ferries; on the other hand, it is expected to develop new traffic as has been the case with other improved traffic routes across waterways, such as the Philadelphia-Camden Bridge across the Delaware, the Bear Mountain Bridge across the Hudson and the Holland Tunnel. Such additional traffic will probably consist, to a considerable extent, of through traffic between northern New England and northern New York.

This article on the Lake Champlain Bridge is an abstract of a paper presented by Professor Spofford before the fall meeting of the American Society of Civil Engineers on October 10. Many members of the Institute faculty are distinguished, not only along academic lines, but by their activities in their respective professional societies and their accomplishments in the practical application of their engineering abilities. Professor Spofford, member of a prominent Boston firm of consulting engineers, is unquestionably a member of this group.

From an engineering standpoint, the bridge has several features somewhat out of the ordinary and worthy of note. The steel trusses are of the continuous type which has not been much used in this country before, so laid out that the center span has the appearance of an arch but without the serious disadvantages which would result from the large horizontal thrusts an arch would produce. These thrusts would be of such magnitude that to carry them to bedrock at the great depth at which it lies at the bridge site, would require large and expensive piers, the cost of which would be excessive.

The method of building the bridge piers in the deep lake water involved the construction of open cofferdams which are really large steel boxes open at the top and bottom. The sides of these boxes were formed of interlocking steel piles driven to bedrock. After the piles were driven, the mud within the cofferdam was dredged out, that adhering to the steel work being loosened before the dredging was completed by powerful hydraulic jets. The removal of the mud and its replacement by the lake water filtering through the walls of the cofferdam resulted in the samples of water from the interior of the cofferdam being freer from sediment than that of the lake water outside. After the removal of the mud, the rock bottom enclosed within each cofferdam was examined by divers to make sure that it would be suitable for supporting the pier; the concrete for the pier footing was then deposited by buckets which auto-

(*Continued on page 248*)

Fairchild Aeriel Surveys

THE LAKE CHAMPLAIN BRIDGE

The steel trusses are of the continuous type, and do not have the serious horizontal thrusts which an arch produces.

Modernism in Architecture

New uses for buildings and new building materials give new fields for creative ability

By JACQUES CARLU
Professor of Architectural Design
Massachusetts Institute of Technology

THE Greeks did not believe in Art for Art's sake. In the Socratic doctrine beauty is one with truth and goodness; as with the ancients, beauty was the counterpart of utility. Their art has always been the expression of society as it was society's willing servant and it is because utility was always foremost in their thoughts that the works of Greek artists never ceased to be a language, a means of understanding between all Greeks.

But forms, like all other human creations, are perishable.

A classical culture strongly based on a broad and very careful study not only of the glorious monuments of the past but also of the æsthetic spirit which animated the human mind in all architectural expressions of its artistic adventure, far from giving us an unreasonable idolatry for what is gone forever, on the contrary should allow us a robust, pertinent and living criticism in all matters pertaining to our present-day living architecture.

Each form of art belongs to a definite period. The ideas and expressions of any one period indicate definitely the needs and thought of that period. We cannot escape this conclusion any more than the human being can fail to obey the eternal laws of life.

Is not life effort alone; movement and action express man's richest endowment? Dynamic equilibrium is impossible, and no society, no form of art, can resist the general stagnation that would result from a cessation of progress.

Art should be as alive as we are and art does not lie in one form or another, but in a principle, in an expression of human thought, in a logical method; thus there is no reason for maintaining that art which does not conform to a certain standard is not art, and that all other expressions are pure barbarism.

Art which does not advance dies.

The modern world is in active evolution, our civilization is not decadent, even finished as some traditionalistic people insist. The periods of decay are those in which men repeat themselves and not those in which men invent.

The contemporary architect is he who is a bond between yesterday and tomorrow, who connects the memory of the past with the expectation of the future. If he sometimes appears to be in opposition to his own time it is because he has within himself that which is invisible to the blind multitude, the rhythm of the future.

All great periods were intensively modern but they were no longer so when out of touch with life, when all activity was concentrated on reviving the past, when archæological knowledge took the place of receptiveness and of the spirit of life.

Modern architecture does not mean to the progressive architect a modern style but an opportunity to give a frank expression in architectural design of our present-day civilization of the age of steel, reinforced concrete, and machines that we have reached. It means the finding of an adequate solution to endless current necessities which in days gone by would have been considered the quintessence of luxury, and the study of entirely new structural and economical problems.

> *"Is it not the function of a beautiful body, is it not its utility which demonstrates to us that it is beautiful?"*
>
> *"And that all we find beautiful; faces, colors, sounds, crafts, all that; is it not as much beautiful as we find it useful?"*
>
> — PLATO.

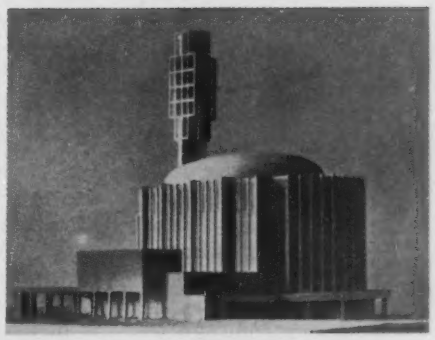
This modern movement in architecture has started enthusiastic research and experiment in the logical applications of the new materials available for building and will bring into the art of architecture new forms essentially appropriate to the materials out of which they are made.

Architects and engineers are readjusting their technic, their taste and their imagination to new materials.

There are new fields of limitless possibilities in this evolution of significant forms and beautiful textures in which every element should be determined by inflexible logic.

Never in the history of civilization has such an inexhaustible wealth of materials been placed at the disposal of the architects.

Legitimate modernism has demonstrated its point. On all sides we can discover evidences of this victory. It has entered all fields and there is an evident effort to eliminate that which has only the appeal of the bizarre or the extravagant.



Reality has again resulted in Romance; Architecture since the eighteenth century has been struggling with a problem which is at length solved. The modern structure is here with the world today and from the European shores goes a wave of modernism that is the result of thirty years of effort.

Against a solid geometrical and logical background architecture has rediscovered its laws. It has recovered its rationalism and its feeling for columns, for forms, and discarded what is useless. It is the enemy of false ornamentation.

Pressing closely to essential truth it is sober, clean and unadorned as are divinities. This modern architecture is really a living one freed from the oppression of the styles. Moreover, a style cannot be invented and it cannot be retained. It is the beating of the heart in the breast of humanity.

Volumes and surfaces are the only elements by which architecture manifests itself. But these volumes and these surfaces are determined by the plan of the structure.

It is the plan which is the generator. If the plan requires the most severe discipline, it requires also the most active imagination. So much the worse for those who are lacking in this imagination.

In the realm of the use of the materials at the disposal of the modern architect he will remain stupid in spite of all the modernism of its means if he has no imagination and if he cannot obtain from these materials some results which would answer his daring dreams of a modern man.

The modern architect would express his personality also through composition.

Composition is the introduction of intellectual order in the chaos of knowledge and sensations. Composition is necessary. It is the daughter of the imagination. In architecture it is the research for unity.

As craftsmanship becomes more rare and expensive, richness of material is to be preferred to complicated ornamentation. There will be no more decorative motives attracting the eye in every direction.

(Continued on page 244)

The Transmission of Sound

The controlling of noise conditions is a problem of ever increasing importance

By WILLIAM R. BARSS '07
Assistant Professor of Physics
Massachusetts Institute of Technology

WE are living in an age of noise. Our modern office and factory equipment is largely a matter of machines, and where there are machines there is also noise. The various noises attendant to increasing street traffic are becoming a serious menace to human peace of mind. The roar of airplanes is a matter with which we must soon contend.

On every hand we are confronted with the problem of controlling these various noises. Those in charge of the construction of churches, hospitals,

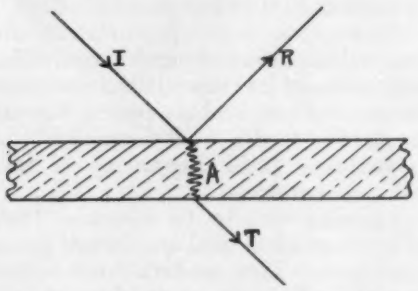


FIG. 1. EFFECT OF AN OBSTACLE ON SOUND

Of the incident sound (I) some will be reflected (R), some transmitted (T), and some absorbed (A).

auditoriums, office buildings, etc., are becoming cognizant of the fact that we have an ever increasing noise condition and are anxious to know what can be done by way of a remedy.

Noise, no doubt, has certain detrimental physiological and psychological effects on the average human being. This is known to be true in the case of many of the lower animals. Noises of certain types will kill fish. A dog will howl if he hears a noise he does not like. Claims are made that cows will give more milk of a better grade if they are subjected to quiet rather than noisy conditions. The writer once knew a cat of probably better than average feline intelligence. This cat was much disturbed when a person whistled in his presence. He would wake from an apparent sleep, jump on the person who was whistling and put his paw on the person's mouth. If the whistling stopped he would purr contentedly; if continued beyond his control, he would leave the room. While a human being cannot be compared to the lower animals, who among us does not, at times, feel like howling in the presence of a disagreeable noise or who does not feel like putting his paw on a particularly noisy machine and silencing it forever?

It is reasonable to suppose that there is an increase in the consumption of bodily energy when a person is living in noisy versus quiet conditions. Hand in hand with this, it is reasonable to suppose that there will be a decrease in working efficiency as the noisy condition increases. It may be further assumed that a person will suffer ear fatigue and temporary or even permanent deafness to frequencies to which he is subjected. These and many other similar questions of a physiological nature are open to further investigation.

The control of sound may be divided into two groups. First, the control of sounds which originate in a closed room and which may give trouble in this room. This is the general question of reverberation and its remedy and is one which is on a sound scientific basis. It will not be discussed further in this article. Second, the control of sounds which originate outside a room and which, by the processes of transmission and conduction, may get into the room. This general question of sound insulation presents many difficulties and no adequate solution has as yet been obtained. Transmission depends on the nature of the structure through which the sound passes, and, as such structures are so complex and so variable within themselves, it is obvious why a general solution is so difficult to attain. Since sound insulation involves transmission, the purpose of this article will be to mention briefly a few of the facts that have been determined regarding transmission.

When a sound wave strikes an obstacle, such as the wall of a building, three things take place in varying proportions. First, some of the energy in the incident wave is reflected by the wall. Second, some is transmitted through the wall and third, some is absorbed by the material of the wall. This is illustrated in Fig. 1, in which I, R, A and T stand for the energy incident, reflected, absorbed, and transmitted respectively. There is a large variation in the values of R, A and T even for the same value of I, the variation depending on the nature of the wall. For example, a smooth hard plaster has a high value for R and relatively small values for A and T. On the other hand, felt has a low value for R and relatively high values for A and T. The reflected energy stays in the room in which the sound originated and can be treated under the head of reverberation control. The absorbed energy is transformed from sound energy to heat energy and is

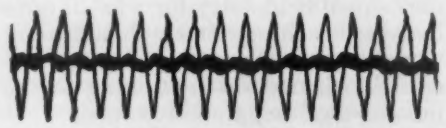


FIG. 2. A RECORD OF TRANSMITTED SOUND

The wide amplitude is that of the sound transmitted through air; the small amplitude, through a material under study.

not recoverable as sound energy. The energy transmitted remains as sound energy and is the basis of most of our insulation problems.

Since the problem of sound transmission cannot be solved theoretically, it must be studied experimentally. In the past year a method has been devised in the Institute acoustics laboratory for measuring the amount of

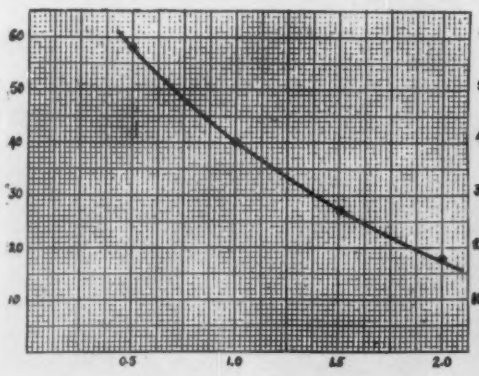


FIG. 3. RELATION BETWEEN THE THICKNESS OF MAT AND ITS TRANSMISSIVITY

The amount of sound a material transmits decreases exponentially with increasing thickness.

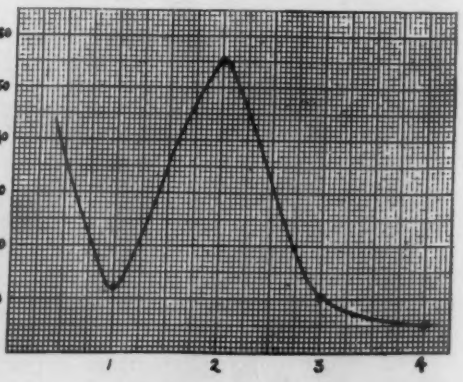


FIG. 4. A MATERIAL WITH A BAND OF NATURAL FREQUENCIES

This material responds more readily to certain frequencies at a certain thickness than at others.

sound energy transmitted through a material and also for studying the quality of the transmitted wave. This method is as follows. The source of sound used is a vacuum tube oscillator which gives nearly pure tones ranging in frequency from 65 to 10,000 cycles. This range includes practically all the frequencies occurring in speech, music and ordinary noises. The output from the oscillator is put into a loud speaker unit which is placed at the focus of a parabolic reflector.

The reflector and loud speaker unit are placed in a booth which has a removable panel, otherwise the booth is soundproofed. The plane parallel beam of sound from the reflector is then passed through the open panel, or through the material under study which may be inserted in the panel. On the outside of the panel is placed a pickup mechanism consisting of a microphone and several stages of amplification. The output from the amplifier is connected to an oscillograph through a specially designed impedance matching transformer. A camera attachment on the oscillograph enables one to make a permanent record of both incident and transmitted waves.

If the source is a pure tone, a study

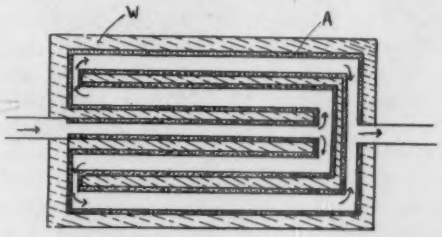


FIG. 6. A SOUND BAFFLE BOX FOR AN AIR DUCT

This arrangement is usually effective in preventing transfer of sound, but does not retard passage of the air.

of the amplitudes of the incident and transmitted waves will give the fraction of the incident energy which is transmitted, assuming of course that air, the medium of the incident wave, is 100 per cent transmitting. If the source is a complex tone, the relative energies are determined by a vacuum tube voltmeter across the output of the amplifier. In case the source is complex, oscillograms are very helpful in determining any change in quality which has taken place during transmission.

Figure 2 is a typical oscillogram. The wide amplitude is that of the wave transmitted through air, the narrow amplitude that of the wave transmitted through the material under study. The frequency used was 512 cycles and this particular material transmits about 5 per cent of the energy which is incident upon it. (For purposes of reproduction the negative had to be retouched, which has introduced some irregularities not present in the original.)

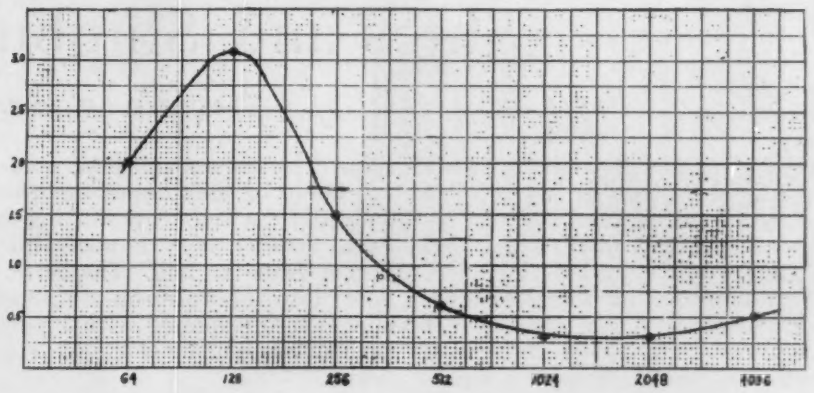


FIG. 5. RELATION BETWEEN FREQUENCY AND TRANSMISSIVITY

This material transmits sound more readily at some frequencies than at others.

Watson * has shown that if the frequency and intensity of the source are kept constant, the transmitted energy decreases exponentially with the thickness of the material. This is a case of what we may call "normal" transmission and holds generally for at least finite thicknesses. Figure 3 shows this effect. The ordinates of this curve are per cent transmission and the abscissæ thickness of the material measured in half inches. The results indicate that a thickness is soon reached beyond which the transmission decreases but little.

There is another kind of transmission which may be classed as "abnormal." A wall has a natural frequency or band of frequencies to which it will respond much more readily than it will to frequencies outside this band. Or, a substance which will not resonate to a certain frequency may resonate to that frequency if its thickness be changed. This is illustrated in Figure 4 in which ordinates represent per cent transmission and abscissæ thickness of material. For one thickness the transmission is about 12 per cent. For double this thickness the transmission goes up to 55 per cent for the same frequency, and for triple thickness comes down to 10 per cent.

The double thickness is just right for a resonant condition at this frequency. The partition acts as a separate source of waves, setting up a compressional wave on the side of the partition opposite the source. A small amplitude of vibration in the partition is sufficient to set up this kind of transmission as the amplitude of sound waves is small, varying from 10^{-8} inch for a very weak sound to 4×10^{-3} inch for a very loud sound.* This type of transmission is often known as "drumhead" action. It usually occurs in thin flimsy structures and is found to decrease rapidly as the rigidity of the structure is increased.

It has also been shown that the same material shows a different transmission for different frequencies. Usually this effect is selective, that is, the transmission will be relatively large over a narrow frequency band and will fall off on either side of this band. Figure 5 shows a transmission frequency curve for a birch door panel one-half inch thick. The ordinates of this curve are per cent transmission and the abscissæ frequencies plotted on an octave scale. At or near 128 cycles the transmission is maximum, falling off rapidly on

(Continued on page 240)

*F. R. Watson, "Acoustics of Buildings".

*Shaw, "The Amplitude of Minimum Audible Impulsive Sounds." Proc. Roy. Soc. 1905.

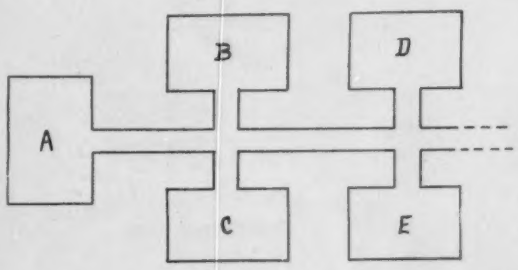


FIG. 7. A NOISY VENTILATING SYSTEM

Noise originating in any one of the rooms B, C, D or E has ready access to the others.

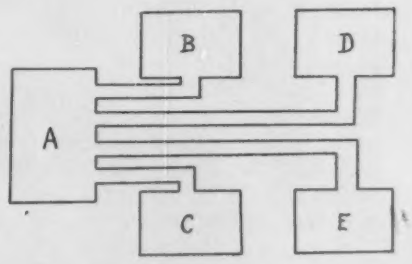


FIG. 8. A QUIETER VENTILATING SYSTEM

Noise to pass from one room to another must now pass through the blower room, A.

Ships and Shipbuilding

First of a series of pictorials on American industries

THE TECH ENGINEERING NEWS is planning to publish a number of pictorial sections devoted to industrial plants. A short sketch of the industry will be included, with a number of photographs illustrating the most interesting phases of the industry.

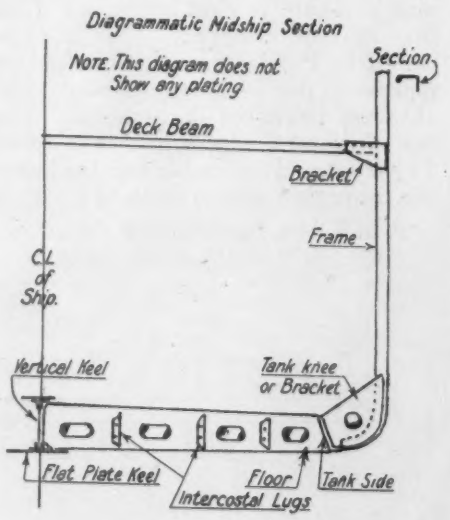
For the first of these series it is appropriate that the shipbuilding industry be selected, since it was to this trade that America first turned her attention. In 1607, thirteen years before the arrival of the *Mayflower*, the *Virginia*, a ship of thirty tons, was launched on the coast of Maine. From this small beginning, American shipbuilding grew steadily until the Civil War. It reached its peak immediately before the War. Over two thousand ships were launched in 1855. The Civil War, however, engaged the resources of the country in an internal contest, attention was withdrawn from sea traffic, and commerce was neglected. A period of decline in the shipbuilding industry followed. Due to the extension of railways, coastwise trade diminished. English builders were able to produce iron ships long before American shipbuilders were able to do so. Furthermore, American builders were not able to compete with foreign builders because of the high wages necessary to attract American men to the shipyards. Whereas, in 1856, ninety per cent of our foreign commerce was carried in American-built ships, in 1913, only about twelve per cent was so carried.

The outbreak of the World War, in 1914, awoke a desire in the United States for naval preparedness. Moreover, there was an unrivaled opportunity for America to gain a foothold in foreign commerce. While the ships of the principal European nations were entirely withdrawn from commerce or seriously hampered in their pursuit of it, American ships could fill not only her own needs, but those of other nations as well. A number of corporations were formed expressly for the purpose of stimulating American foreign trade. The entrance of the United States in the War naturally brought with it an exaggerated demand for merchant and war vessels, a demand which was filled, so that after the War a sharp decline was experienced.

Ships, and the yards in which they are made, are more or less standard in their nature. The yard and ship pictured here are typical of a good many others. The building berth is a vital factor in the construction of a ship. The ground must be solid and not liable to shift under the growing weight of the hull. Any shifting would cause endless delay in removing distortion from the hull. The berth runs down into the water on a gradual incline. It is supplied with cranes for the efficient placing of the various hull members during construction. There are several types of cranes, the most popular being the gantry (Figures 11, 12, 13) and cantilever (Fig. 14) types. The gantry cranes run on framework the length of the berth. They are equipped with a device allowing transverse motion. The cantilever type allows horizontal motion through 360°, a fore and aft motion on the horizontal member, and in some cases, the whole crane can be moved up and down the berth.

The progress in construction of the steel ship is strikingly illustrated by this series of photographs. The ship is the Pennsylvania, launched from the yards of the Newport News Shipbuilding and Drydock Company, at Newport News, Virginia. The launching of this vessel provoked much attention and comment, as it was one of the largest merchant or passenger vessels built in the United States.

The keel of the Pennsylvania was laid October 15, 1928, and the ship was launched July 10, 1929. Her sea trial took place on October 3, 1929. The ship is 613' 3" length overall, beam 80' 0", depth 52' 0". Her load displacement is 14,800 long tons.



CROSS SECTION OF A STEEL SHIP

Reference to this diagram will aid the reader in picking out the details of construction, as shown in the photographs.

As far as the members of the hull are concerned, they may be prepared at the shipyard itself or at some other plant, the yard serving merely as a place to erect the hull. The principal hull members are as follows: there is a flat plate keel to which is connected by means of angle bars the vertical plate keel (Fig. 1). Both of these run the whole length of the ship, and to the latter are riveted, at equal intervals, brackets. To the brackets in turn are fixed, at right angles to the vertical keel, the floors (Fig. 2). These are punched with holes, except where water-tightness is desired, to reduce weight (Fig. 3). The floors also have brackets arranged at equal intervals from the center line. These are arranged to take the intercostals (Fig. 3), or plate structures, included to stiffen up the floor structure longitudinally as well as to keep the floors in their places relative to the center keel, and to each other. The floors and intercostals both go to form the cellular double bottom. The skin of the ship, or shell plating, is attached to both top and bottom of the double bottom structure, the top plating (Figs. 4, 5, 6) being known as the tank top plating, and the whole being water-tight. Thus, although a ship may damage severely her shell or outer bottom plating, it is still possible for her to float safely on her tank top or inner bottom plating. By means of solid floors the cellular double bottom is divided into watertight compartments or tanks; these are useful for the storage of fuel oil, feed water, or fresh water. The floors at their outer ends in most ships slope outwards from inner to outer bottom, and in order to finish the tanks, a tank margin plate (Fig. 3) is arranged along the whole length of the floors, having brackets at regular intervals. The object of these is to take large brackets or tank knees (Fig. 5) to which have been fixed, before erection of the ship, the frames (Figs. 5, 7, 8, 9) themselves. To one, two, or three places along the lengths of the frames, according to the type of ship, are smaller brackets (Figs. 7, 8, 9) to which are fixed the deck beams (Figs. 7, 8, 9). On the deck beams, the deck plating (Fig. 11) is arranged, and on the frames the side,

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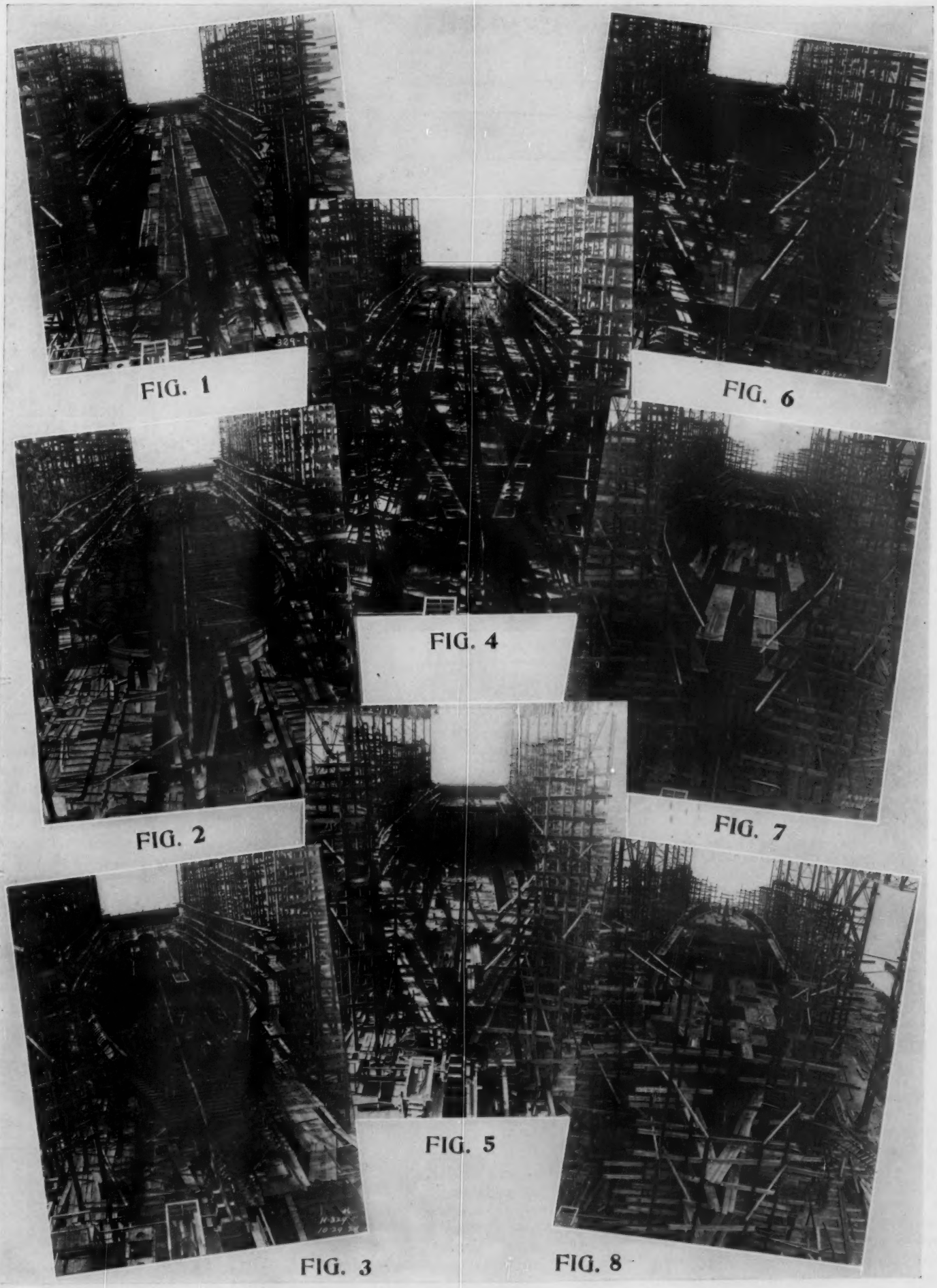


FIG. 1

FIG. 6

FIG. 4

FIG. 2

FIG. 7

FIG. 5

FIG. 3

FIG. 8

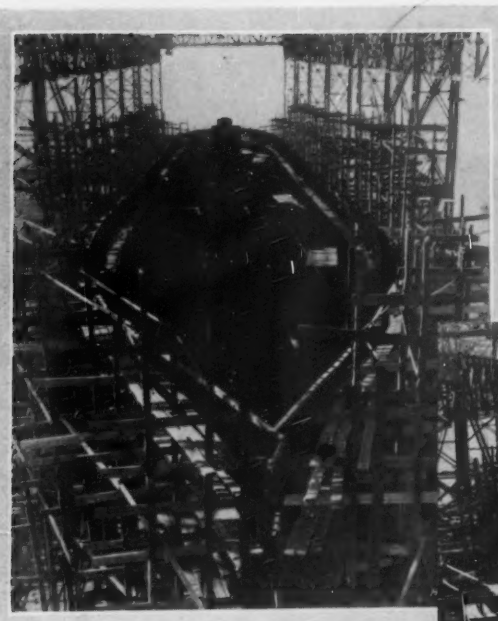


FIG. 9

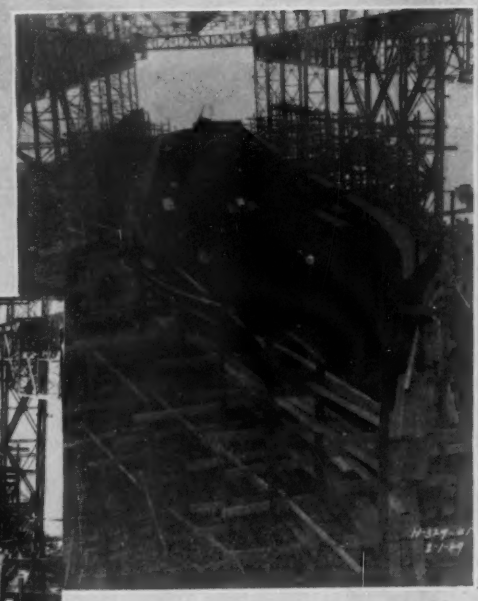


FIG. 10

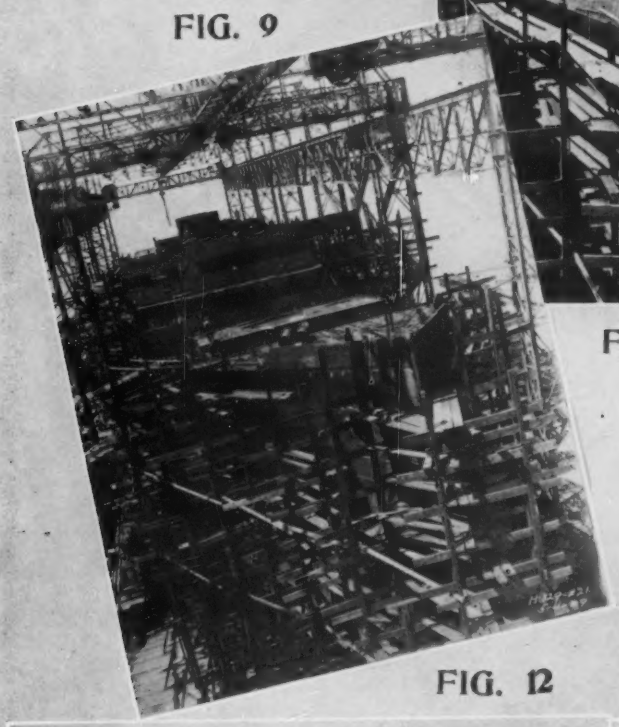


FIG. 11

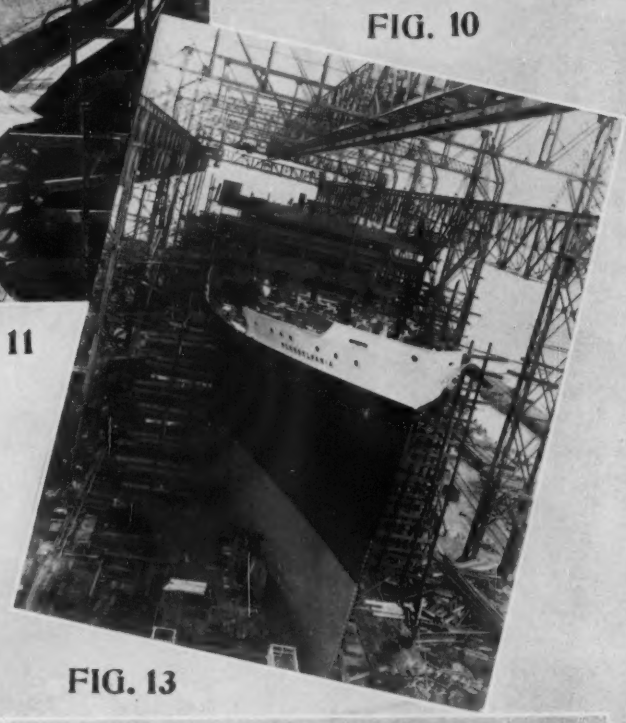


FIG. 12

FIG. 13

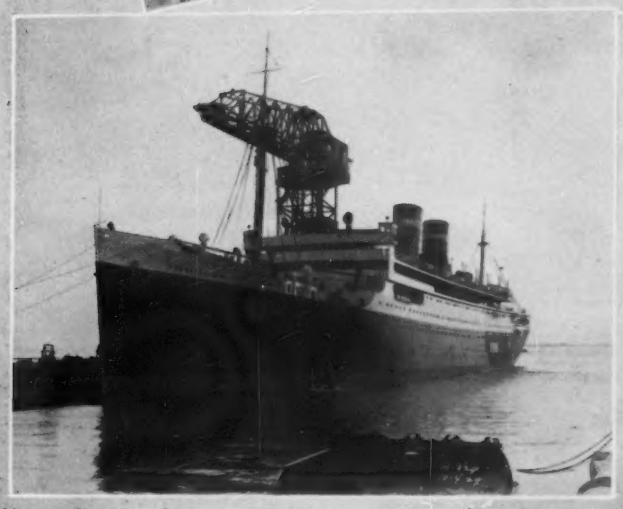


FIG. 14

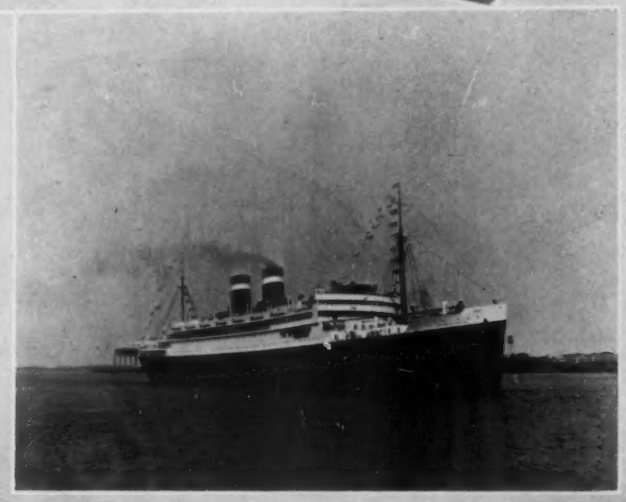


FIG. 15

Editorials

CONVENTION HIGHLIGHTS

Returning from the annual convention of the Engineering College Magazines Associated, the delegates of THE TECH ENGINEERING NEWS bring with them many ideas and suggestions for the improvement of the magazine. The E. C. M. A., as we call it, numbers twenty-three undergraduate engineering publications united for the benefits which come from the handling of national advertising and the discussion of problems common to all.

Perhaps the most important question before the group centered on the publication of "objectionable publicity" for industrial concerns. The T. E. N. has always maintained that publicity matter of any nature was highly objectionable, and we have tried to keep our pages free from this sort of "unpaid advertising." A former ruling stated that such material might be used, if it bore the signature of an alumnus or student connected with the magazine. This, we felt, was a violation in spirit of the principle involved, although, in the letter, it conformed to the standards set. The matter was argued at length, and, in the end, our views were in harmony with the new principles established.

At the convention, two publications were admitted to membership in the group. These were the *Marquette Engineer* of Marquette University and the *Auburn Engineer* of Alabama Polytechnic Institute. Both are well established magazines that can lend strength to the organization, as well as receive help from it.

In the distribution of awards, the T. E. N. was entered in four competitions, and placed in three of them. First place for the best editorial of the year was given to "Einstein," by John H. Dodge, Jr. '31, in our April issue. Third place was awarded for the best cover design, and third for the best illustrations throughout the year. Again, our efforts have been recognized, and again, we have seen new responsibilities and new problems to be met during the coming year.

CULTURE IN ENGINEERING EDUCATION

In an article published in this issue Professor Emerson has pointed out the ways in which a student at the Massachusetts Institute of Technology may broaden his cultural training both through the Institute's general studies, lectures and concerts, and through the numerous facilities offered in Boston for the acquisition of such training. Whether or not we, as students, make full use of them is another question. We have earned the reputation of being hard-boiled engineers, and glory in it. There is a tendency to look down on cultural subjects as superfluous in the life of an engineer.

The trouble is that cultural subjects cannot be enjoyed at once. Careful training is necessary before one can appreciate and enjoy. Lacking that training, we cannot understand culture, and so disregard it. To appreciate music, the listener must understand its fundamentals, know the circumstances in which a particular piece was composed, and something about the composer. The same sort of things might be said about all the fine arts.

One might reasonably object that the crowded courses of instruction required for the proper training of the students for their life work leaves no time for anything else. That is quite true. There are two things that can be done, however, to get rid of this undesirable situation. One is to extend the course of instruction over five or six years, instead of the customary four. The other is to require two years at a college of liberal arts as an entrance requirement. Other professions, such as law, medicine, etc., have already resorted to this expedient. It probably could be applied as successfully to the engineering profession.

THE COVER

Our cover for the November issue is taken from a photograph of a popular hotel at one of the New Jersey shore resorts, which was featured as one of the prize exhibits of the 1928 Philadelphia Architectural Exhibition. This special view of the hotel presents a striking modernistic effect, by the use of lines, shades, clouds, and also the water in the foreground, such that the building seems to be almost a vision and not a reality.

PROFESSOR CHARLES M. SPOFFORD

Bachrach

Professor Spofford, Head of the Department of Civil and Sanitary Engineering, has experienced a career culminating in his recognition as one of the most eminent authorities in his field. It will serve as an inspiration to every Tech man striving toward success in the field of pure engineering. We are recounting in this, the fifth of our series of faculty sketches, a few of the more important items from his life which should prove to be of great interest to those students who are not familiar with his work.

His elementary education was obtained in the public and high schools of Newburyport, Massachusetts. He entered the Institute in the Class of 1893, and was graduated with the degree of S.B. in Civil Engineering. This was followed by one term of graduate work and two years of professional experience in the field of bridge engineering.

In 1896 he returned to the Institute as an Assistant in Civil Engineering. The following year he was appointed an Instructor in that department and served in that capacity until 1903, when he was promoted to the position of Assistant Professor.

In 1905 he accepted an invitation to act as Professor of Civil Engineering at the Polytechnic Institute of Brooklyn. In 1909 he returned to the Institute as Hayward Professor of Civil Engineering, and in 1911 was made Head of the Civil and Sanitary Engineering Department, which position he has held since that time.

In addition to his activities at the Institute, Professor Spofford has been engaged in outside work in the civil engineering field. He is a member of a well-known Boston firm of consulting engineers which has been, since its formation in 1914, in charge of many important civil engineering projects in New England and elsewhere. This work consists of preliminary investigation, design and supervision of construction. He has been identified in this connection with the construction of the Army Supply Base in Boston during the World War, the Hampden County Memorial Bridge across the Connecticut River at Springfield, the Lake Champlain Bridge, of which a description of his own is included elsewhere in this issue of THE TECH ENGINEERING NEWS, and the Syracuse grade crossing project.

Professor Spofford is an active member in a number of professional societies, among which are the American Society of Civil Engineers, of which he was a Director during the period 1925–1927; the Boston Society of Civil Engineers, of which he was President 1918–1919; the Institution of Civil Engineers of Great Britain; the American Academy of Arts and Sciences, the American Railway Engineering Association, and the American Association of Port Authorities.

Amongst his papers may be mentioned an account of an experimental investigation of the holding power of steel rods embedded in concrete, made in the early days of the use of reinforced concrete; a monograph upon Highway Bridge Floors, and a brief account of the life of Thaddeus Hyatt, who was one of the pioneers in the investigation and use of reinforced concrete. He has also done considerable in the seismological field, in which connection will be remembered the meeting of the Eastern Section of the Seismological Society of America at the Institute in 1927, at which he delivered one of the papers. His book entitled, "The Theory of Structures," now in its third edition, is used in colleges and engineering schools throughout the world.

He is a member of Alpha Chi Rho, and the honorary societies of Tau Beta Pi and Chi Epsilon.

The Engineering Field

Abstracts from the leading professional and trade journals

A Rayon-Finishing Machine, which is capable of reducing the high gloss of rayon to a soft silken finish on both sides of the fabric, has been developed by a German concern.

An endless felt runs over two rollers, supported by a heavy frame and adjustable with respect to one another. The lower of these rollers operates against a jacket or shoe made of highly polished non-rusting metal, and the jacket and roller are both steam heated.

The face of the goods is pressed against the felt, and as a result of this arrangement it is possible to subject the material to a great amount of heat and pressure without obtaining the so-called ironing effect. It is claimed that with this machine any desired degree of softness or hardness may be imparted to the goods.

The Big Creek Penstock, built by the South California Edison Company, has proven itself a great engineering feat in pipe-line construction. It is a single penstock serving two 56,000 h.p. impulse units and operates under a head of 2,418 feet of still water. This means a pressure of over 1,000 pounds per square inch at the foot and a maximum water velocity of 540 feet per second.

The penstock is 6,664 feet long and is built of three types of steel pipe. These are: (1) 1,858 feet of quadruple riveted pipe, $\frac{9}{16}$–$1\frac{5}{16}$ inches thick and 108–84 inches in diameter; (2) 3,042 feet banded forge welded pipe, 1.25–2.5 inches thick and 84–66 inches in diameter; (3) 1,764 feet forged seamless pipe, 2.5–3 inches thick and about 66 inches in diameter.

At the foot of the pipe, a Y-shaped forged seamless pipe divides the water into two 48-inch branches which in turn are each divided into two 34-inch branches to the water wheels. A large valve at the top is controlled by a remote control device and automatically closed by a Venturi tube if velocity becomes 100 per cent above normal. Joints in pipes are packed with flax, and between pipes and concrete supports the spaces are packed with two $\frac{1}{16}$-inch sheets of highly compressed asbestos impregnated with graphite. As the plant is closed several months in the year, the penstock may be inspected and repaired often, insuring good service.

Steel Scaffolding has come to be recognized by the engineer as the foremost type of framework for building construction; for the sake of safety, compactness, and durability, and also because of its fireproof qualities, eliminating all danger of the old-fashioned but costly wooden scaffolding fires.

The steel framework consists of 2-inch tubular members. The galvanized tubes come in 6, 10 and 13-foot lengths, and are tightly bolted together at right or oblique angles as may be desired by the use of standard and adjustable couplers. The tubes are connected together in series by a locking

Courtesy *Scientific American*

STEEL SCAFFOLDING

Showing the fireproof network used in renovating a church.

device which allows ends of adjacent tubes to be slipped one inside the other, and held firmly. Bases are provided for the vertical ground members where these are to rest on the ground. Cross members, locked into the side of the building through the aid of clincher plates, support the scaffold planks, which are fireproofed by means of chemicals deeply impregnated under heavy pressure to prevent washing out.

Glasgow's 720-Ton Refuse Incinerator is the latest improvement in the disposal of ashes and garbage.

Refuse is brought to the destructor, unloaded, and weighed, whereupon it is divided for the four furnaces. After screens have separated the fine from the coarse material, metal is removed by an electromagnet and sold. After pulverization, the coarse tailing passes, with the fine, to destructor furnaces, from which clinkers are removed and sold whole or crushed for manufacture into concrete. The heat of combustion of the refuse is used to generate electricity which operates all electrically-driven equipment in the plant. Any excess of current is sold to the Glasgow municipal department.

The original cost of the plant, nearly three million dollars, was high, but the benefits and profits incurred by its installation overshadow its expense. Dust and smoke are almost entirely absent, and, except for political differences which would arise (and have arisen) over the sale of electricity, the system speaks well for its own extension to other municipalities.

The Front-Wheel Drive Car, brought out a few months ago by a leading automobile manufacturer, gives promise of instituting a new era in automobile design and construction.

The motor is a straight eight and had to be specially built for the new car to take care of the inevitable changes imposed by the front-wheel drive. While the usual type of automobile transmission carries the counter shaft and gears under the main shaft, this new transmission lies on its side. Moreover, to insure the reliability of the car, with all the transmission and drive equipment packed in such a small space in the front of the car, extreme care had to be taken in the forging and machining of the transmission.

In order to have the front axle support the car, allow the front wheels to turn, and drive them, two axles are used; one to carry the weight of the front of the car and to hold the wheels and steering gear, and the other to transmit the power. The former is a hollow tubular axle, carried in front of the latter, and in order that the wheels and the power axle shall line up properly, the ends of the support axle are bent back at an angle of forty degrees.

An unusual design feature is the position of the front brakes which are placed in an extension of the differential housing, not on the wheels, and are completely enclosed.

There are several advantages of the front-wheel drive system. Since the rear axle is "dead," a large clearance for the differential housing is avoided, and the body can be set closer to the ground. With the rear spring taking no driving action, and merely serving to

support the body, and with the engine pulling the car, not pushing it, more comfortable riding will be insured. About the only disadvantage is that, due to some torque in the front wheels, steering becomes a trifle difficult.

An Intense Flame, which will melt its way through any known solid substance, is produced by a new type of blowpipe, employing finely powdered aluminum instead of the more familiar hydrogen or acetylene gases.

A screw conveyer carries a slow stream of aluminum dust from the bottom of a hopper out through the open end of a brass pipe. The dust is here met by a swift cross-stream of oxygen, with which it forms a fine and uniform suspension. From this point the mixture is passed forward through a larger tube, which a little farther along is divided up into eight smaller tubes. The latter diverge from the central tube for a short distance and are then curved back inward so as to come to a sharp focus. The aluminum-oxygen flame can be lighted at this focus point with a match or Bunsen burner.

The blowpipe combines the principles of the well-known oxyhydrogen or oxyacetylene blowpipes with that of thermite, a powder used for the generation of intense heat on a limited area, such as the ends of rails in welding. Thermite consists of aluminum powder mixed with another chemical which on heating yields free oxygen at a rapid rate. In the new blowpipe the oxygen is supplied directly in the form of a gas instead of being generated on the spot from a chemical.

A Compact Automatic Welding Kit has been devised which gives positive speed without slippage, extreme sensitivity insuring instant response to arc voltage conditions, many speeds, light weight, simplicity of design, ease of adjustment, and smoothness of operation.

The equipment consists of the welding head with automatic electrode feed, the control cabinet, and the operator's panel. The machine automatically strikes and holds an arc between electrode and works by the pressing of a button. The nozzle assembly is mounted on the drive motor, which is in a cylindrical frame. In the control box, which automatically changes the speed and direction of electrode feed, clutches and relays are eliminated. The operator's panel is fitted with a "start" and "stop" button, a rheostat, and a switch to reverse the head motor. The kit will operate on either variable, or constant, voltage welding generator sets.

Demand for an outfit of this sort has been aroused by the growth and economy of automatic arc welding in the metal working industries.

Courtesy *Electric Traction*

AUTOMATIC WELDING HEAD

The small pulley in the center of the frame feeds the electrode which projects below.

A Live Ball-Bearing Tail Stock center in a number of sizes and in light and heavy-duty styles has been placed on the market.

The shank is made of high-carbon steel, and is ground to insure concentricity with the revolving center point. The center point is of tool steel and revolves in three radial-type ball bearings, the thrust load being carried by a ball thrust bearing located between two of the radial bearings. In the light-duty type, there are only two radial ball-bearings.

As the center point revolves with the work, it does not receive wear, so that regrinding is never necessary.

Holes in Disabled Submarines may be quickly patched under water by the use of a device tested and approved by the United States Navy. This machine, which resembles a pneumatic hammer, uses a charge of high explosive to drive a steel stud through the shell of the sunken vessel fastening an emergency patch over the rent. This submarine patcher is much faster and more easily handled under water than the slow-working air drill with its cumbersome hose used in the old method. It drives a steel stud three and one-half inches by one-half inch through a half-inch steel plate at a single blow, whereas before it was necessary to drill a hole and then bolt or rivet the plate to the side of the submarine. The invention of this tool will permit submarines to be raised in half the time before required and may result in the saving of lives which would otherwise be lost.

A New Side-Wheel Trenching Machine is being manufactured by a Wisconsin concern which will dig trenches from 20 to 28 inches wide and to a depth of 5 feet, its power being a 55 h. p. heavy-duty engine. The cutting wheel of the machine projects 2 feet beyond the outer edge of the crawler, making it possible for the traction mechanism to remain on the level road. This location of the excavating mechanism at the extreme side permits cutting close to poles, curbs, or other obstructions, especially to the edge of a highway.

A Mechanical Carrier for libraries is now being installed in various sections of the country. It promises to revolutionize library planning, and is the last word in efficiency in this "Push-button Age." The two-way book distributor consists of an endless chain, running continuously from the main desk to the book stacks. Carriers eight feet apart convey the books to their destination in a maximum time of four minutes, where an almost human comb rakes off only the books for that section, and slides them into a padded compartment. This box contains a spring bottom which sinks under the weight of the books. As soon as the volumes pile up too deeply, the sinking bottom rings a bell which calls the attention of an attendant. The features of the invention are: its small cost of operation; that it operates in two directions; conveys books horizontally, vertically, and round corners; has distant control; can discharge the books automatically at any desired point; and is constructed so simply that it does not get out of order.

Courtesy *Scientific American*

DELIVERY OF BOOKS

The aluminum-fingered comb automatically rises to remove books from car.

Departmental Notes

DEPARTMENT OF BIOLOGY AND PUBLIC HEALTH

During the months of June and July a Public Health Institute was held in the laboratories of the Department, the purpose of which was to give to health officers and other public health workers an opportunity to familiarize themselves with the latest developments in the various phases of public health work. This is the third Public Health Institute which has been thus carried out in the Department and has been made possible through the cooperation of the Metropolitan Life Insurance Company. The attendance at the 1929 session was considerably greater than in either of the earlier institutes and thirty-four workers from different health departments and laboratories were in attendance. It was especially gratifying to have representatives of city and State departments from the following States: New Hampshire, Massachusetts, New York, Michigan, Minnesota, Illinois, and Missouri. Workers from various local health departments in the vicinity of Boston were also in attendance. At this Institute the instruction is by lecture, discussion and demonstration, and more than twenty experts in the various fields covered were secured to give the lectures and lead in the discussions. This is a field of departmental activity quite outside the academic work since no academic credit is given.

The seventh Sedgwick Memorial Lecture, held under the auspices of the Department, was given at the auditorium of the Marine Biological Laboratory at Woods Hole by Prof. Torsten Thunberg, of the University of Lund, Sweden, on August 16. This lectureship was established by former students and friends of Professor Sedgwick in recognition of the great service which he rendered to biology and the practice of public health in America.

Professor Prescott has undertaken further researches on the chemistry of coffee at the request of the Brazilian-American Coffee Promotion Committee and the National Coffee Roasters Association. He is assisted in this investigation by Dr. R. L. Emerson who has recently visited Brazil for the purpose of securing information and authentic samples of coffee produced under different conditions, and by Messrs. Griswold and Mosher of the Class of '29. Professor Prescott has also been carrying out certain investigations on domestic refrigeration, and especially on the behavior of certain types of food spoilage bacteria in cooked and uncooked foods maintained under different refrigeration conditions. This work has been part of a coöperative research conducted jointly with the Research Laboratory of the Frigidaire Corporation, of which P. K. Bates '24, Ph.D. '28, is the director.

Professor Turner spent the summer in Europe in charge of a group of students who were especially interested in the study of health education problems in school systems. The party visited England and Scotland, France, Germany and Switzerland. The prime object of Professor Turner's trip was to preside at the meetings of the International Health Education Congress which were held at Geneva.

PROF. SAMUEL C. PRESCOTT
Professor of Industrial Biology and is in charge of the Department of Biology and Public Health

Professor Bigelow and Mr. Jennison spent the summer at the Marine Biological Laboratory at Woods Hole on investigation work in zoölogy.

Dr. Blake continued his association with the Mt. Desert Research Laboratory for the study of marine life, continuing the work which he carried out at this laboratory during the summers of 1927 and 1928.

Dr. Horwood made during the summer months a health survey of Holyoke with special reference to tuberculosis and has since prepared an extensive report on this subject.

Mr. Harris, working under the direction of Professor Bunker, has continued investigations in the field of nutrition with special reference to the significance of some previously unrecognized factors which seem to be of importance in the control of growth in young animals.

Dr. Proctor, assisted by Mr. Needle '29, has continued during the summer investigation on a fermentation process yielding butyl and isopropyl alcohols, which was discovered in this laboratory by Mr. Morikawa in 1925.

The investigations on dehydration of food products, which have been carried on for the past two years by Mr. Griswold, have been continued throughout the summer and are still being actively pursued.

A new edition of a textbook on hygiene by Professors Bunker and Turner has been brought out by the C. V. Mosby Company.

SAMUEL C. PRESCOTT, '94.

DEPARTMENT OF MILITARY SCIENCE

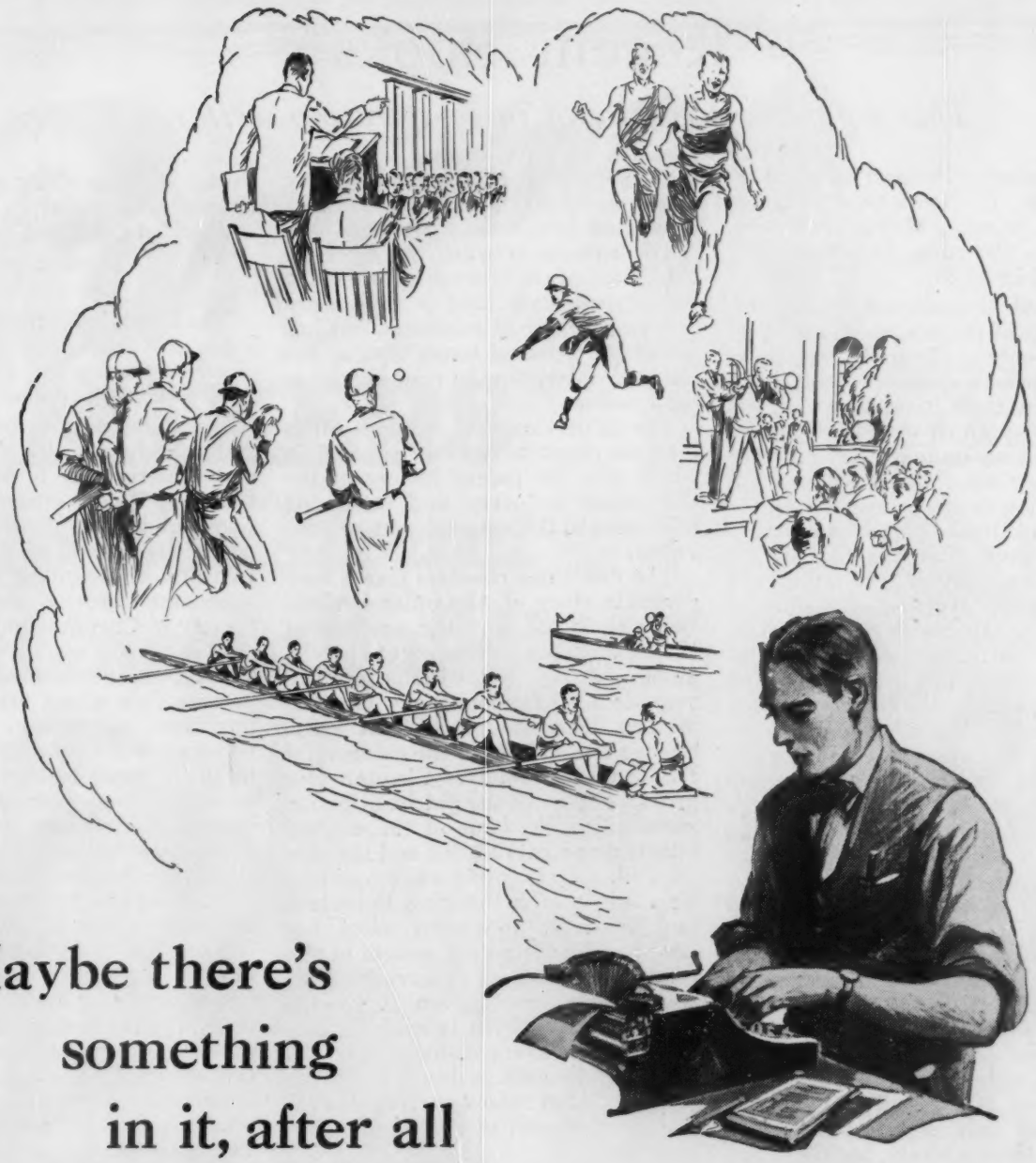
Col. H. E. Cloke, who was relieved at his own request in order to avail himself of an opportunity for foreign service in Hawaii, has been replaced as Professor of Military Science and Tactics by Lt.-Col. Robert C. Eddy, C. A. C., who has been Executive Officer of the Department for the past two years.

Major Robert Arthur, C. A. C., has been detailed as Executive Officer. He is a graduate of the United States Military Academy; has completed a course of instruction at L'Alliance Francaise, Sorbonne University; and is a distinguished graduate of the Coast Artillery Schools, a graduate of the Advanced Coast Artillery School, and a distinguished graduate of the Command and General Staff School. Major Arthur was P. M. S. & T. at the University of Michigan from October, 1919 to January, 1924. During the past four years he has been editor of the *Artillery Journal* at Fort Monroe. During the war, Major Arthur served with the Field Artillery in France from January, 1918 to July, 1919, during which he was Brigade Adjutant, 57th F. A. Brigade, 32d Division, and commanding the 121st Field Artillery in Alsace sector and Aisne-Marne, Aise-Aisne, and Meuse Argonne offensives July to November, 1918. Major Arthur has been awarded the Distinguished Service Medal.

Major S. S. Winslow, who has been in charge of the Coast Artillery unit for the past five years, has been detailed as Director of the Department of Engineering at the Coast Artillery School, Fort Monroe, Virginia.

Major Peter H. Ottosen, who was on duty at M. I. T. from September, 1920 to August, 1924, has returned

(*Continued on page 244*)



Maybe there's something in it, after all

Trying out for the editorial board, Simpson, '33, is all energy. Here, there and everywhere to cover events, he is busy on the write and rewrite—confident that experience will fit him for the post.

And Jones, his roommate, shows equal determination in football. Tackling, bucking the line, practicing signals, he trusts to solid ground-work to get him on the scrub this year.

Good training, both of them. Perhaps there is something in high scholarship, too. Industrial leaders of today think so.

AMERICAN TELEPHONE & TELEGRAPH CO. AND ASSOCIATED COMPANIES — BELL SYSTEM

Western Electric

Manufacturers... Purchasers... Distributors

SINCE 1882 FOR THE BELL SYSTEM

Recent Books

This department conducted in co-operation with the faculty

The General Properties of Matter. *By* F. H. Newman, D.Sc., *and* V. H. L. Searle, M.Sc. *1929. The MacMillan Company, New York. 388 pages. Price $5.50.*

This book is concerned chiefly with the aspects of physics which are of interest not only to physicists, but also to mathematicians, engineers and chemists. The authors have, therefore, left out material which would have been included in an ordinary physics textbook. They say nothing, for instance, about optics, or electromagnetism.

The book treats of mechanics very fully, however. Two chapters are devoted to the study of gravitation; one dealing with accelerations due to gravity, the other with gravitation itself. In the former chapter, for instance, the pendulum in all its branches is studied, while in the latter such questions as Newton's and Kepler's laws are discussed. A whole chapter is spent on theory and applications of the gyroscope; the elasticity of solids, fluids and gases is taken up in detail. Other subjects in which engineers might be interested are carefully renewed; these include problems in vibration and others.

Of especial interest to chemists is the chapter on osmosis and diffusion.

Problems verging on the subject of hydrodynamics are discussed in the chapters on surface tension, viscosity and wave motion in liquids.

The book is especially valuable in that it not only discusses freely the theory of these subjects, but takes care to explain the applications of them. Thus, in dealing with the pendulum, the mathematical pendulum is taken up first, followed by a discussion of pendulums as they actually exist, together with the mathematical formulae connected with them.

Although the reader is assumed to have a knowledge of differential and integral calculus, all necessary mathematics are explained step by step. A notable example of this lies in the chapter on Fourier's Series, which is included to facilitate the study of vibrations.

J. H. D., Jr.

Beginnings of Telephony. *By* Frederick Leland Rhodes. *Harper and Brothers, New York and London. 261+xvii pages. Price $4.00.*

The author of this book, Frederick Leland Rhodes, is undoubtedly one of the foremost scientists and engineers connected with the telephone industry today and will be remembered by some at the Institute for a colloquium he conducted here some years ago.

The subject of which he treats is not handled in the much-ridiculed stereotyped style that is supposedly so characteristic of engineers, but has added the personal touch that makes the book interesting to read as well as informative.

The subject covered is divided into fourteen chapters and four appendices which give the patent history of the telephone industry and a list of references to the original matter consulted.

The first three chapters give a very complete story of Alexander Graham Bell's early life, and the progress of the experiments leading up to his telephone patents. Bell's life is given in very detailed fashion, many personal matters being brought to light which remove the book from the category of the usual biography. Chapter four gives a résumé of the patent litigation surrounding the issue of the original telephone patents to Bell and the subsequent attacks upon their validity. This litigation is the most important and the most protracted which has arisen under the patent system in this country and is well deserving of the considerable space given it by the author. The section is easily understood by the average engineering student as it does not go deeply into technicalities, but merely recounts the results of several of the more important suits.

The remainder of the book gives a connected account of the progress of the telephone industry and the development of the apparatus involved. It is particularly interesting because of the detail with which it discusses the development of such apparatus as the microphone. Appendix A gives a list of the most important lawsuits arising out of infringements of Bell's telephone patents and a description of the circumstances surrounding each suit. Appendix B gives the history of the word "telephone" and its use for various kinds of apparatus long before Bell adopted it. Appendix C gives a complete numerical list of the cited and Appendix D gives a complete list of references consulted in writing the book. This last appendix is invaluable since the sources of much of the information given would be extremely difficult to find.

"Beginnings of Telephony" is well worth reading and should be interesting to anyone connected with telephone work. Because of its patent matter, it should be useful to inventors and students of the patent system.

John N. Fricker '30.

The Chemical Engineering Catalog. *1929 Edition. The Chemical Engineering Catalog Co., Inc., New York. 1205 pages. Illustrated.*

Few industries can boast of so complete a reference book of equipment and materials as is found in "The Chemical Engineering Catalog." Prepared under the direction of a joint committee representing the American Institute of Chemical Engineers, the American Chemical Society, and the Society of Chemical Industry, its purpose is to make readily available to the members of the chemical industries the various data which are necessary for intelligent purchasing. Ordinary advertising of the usual display nature is totally lacking. Instead, the aim seems to be to present as much complete and concise information concerning the products advertised as possible, and to allow the reader to draw his own conclusions as to their respective merits.

Two general divisions into the sections of Equipment and Supplies and Chemicals and Raw Materials are made. In the first group can be found much equipment not directly related to the chemical industries, but of great importance to them, such as power plant equipment, conveying and elevating machinery, power transmission equipment, and construction materials. A trade name index and a classified index of chemicals and raw materials with their manufacturers are valuable features.

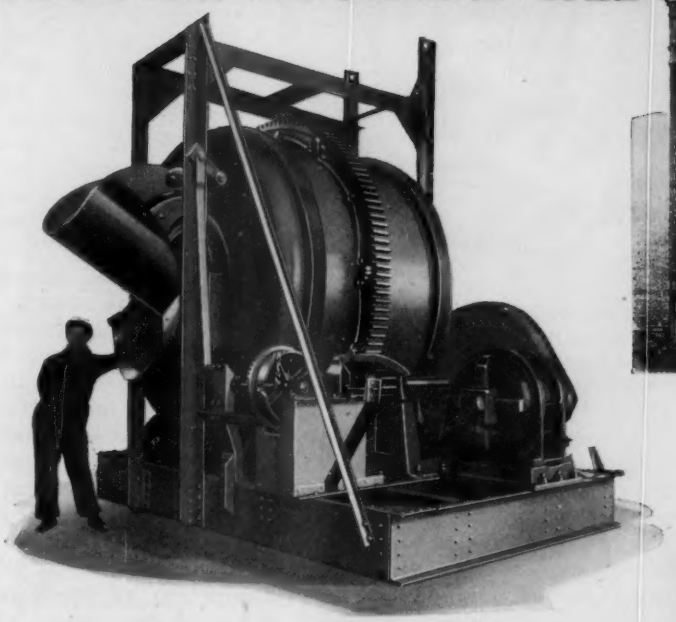
The third major division of the Catalog is the Technical and Scientific Book Section. Here is listed practically every recent or important book of chemical interest, over twenty-six hundred in all. Classified also as to subject matter, the ease of obtaining the desired knowledge is greatly increased.

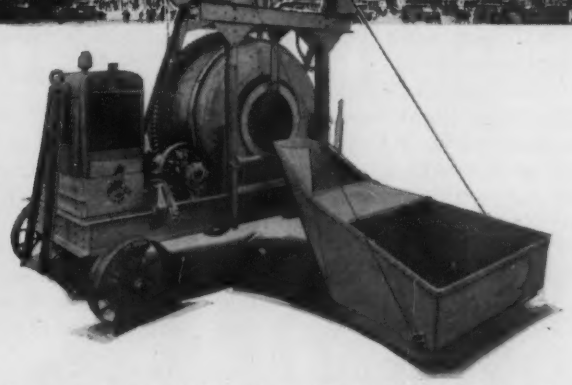
Each year, the Chemical Engineering Catalog has been expanding, revising, and undergoing various changes to make it of greater value to the industry. It serves, far better than could any haphazard collection of individual commercial catalogues and miscellaneous data, to show the chemist and chemical engineer the things available to meet his needs, and the firms from whom they may be procured.

H. S. G., Jr.

9 Ransome MIXERS Help Construct the Lincoln Building

The Lincoln Building—Madison Avenue and 41st Street, New York City—53 stories high. Dwight P. Robinson & Co., Inc., Builders. J. E. R. Carpenter & Associate, Architect





Concrete for the foundations and footings is supplied by the Ready Mixed Concrete Corporation of New York City who operate one 84-S and one 42-S Ransome Mixer in their Central Mixing Plant.

The Pietrowski and Konap Company used two 21-S Ransome mixers to pour the concrete for the floors and arches.

The Benedict Stone Corporation of Tuckahoe, N.Y., who own five 21-S Ransome Mixers built the facades in cast stone.

Because of their large output and speed of operation, Ransome Mixers are being used by leading contractors in constructing many of the important buildings erected to-day.

Tell us the size mixer you need and let us send you complete information.

Ransome Concrete Machinery Company

1850—Service for 79 Years—1929

Dunellen **New Jersey**

Military Mechanization

(*Continued from page 221*)

tirety or by the use of such major units as engines, rear ends, transmissions, etc., when it is necessary to build non-commercial types.

A satisfactory type of vehicle must represent a compromise between the following principal factors:

Mobility sufficient to keep up with the command of which it is a part over whatever terrain it may be called upon to traverse;

Power sufficient to carry a reasonably useful load in addition to the weight of the vehicle itself;

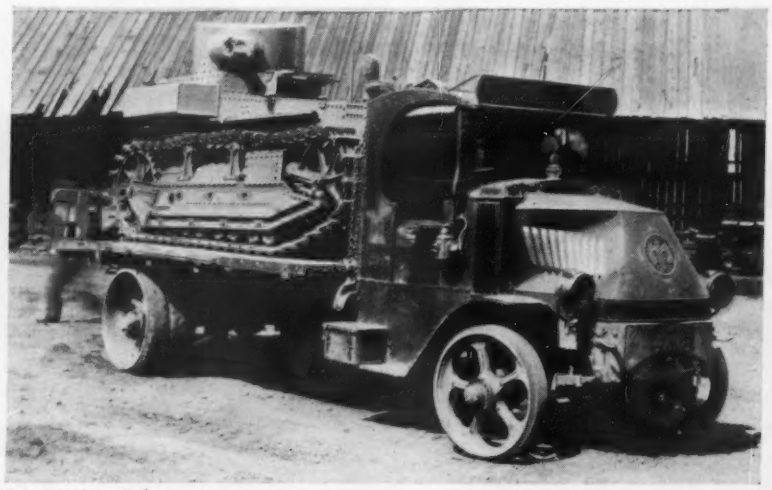
Armor Protection — never very thick and frequently omitted entirely;

Total Weight limited by nature of roads and ground over which tank must operate;

Procurability — design must be capable of rapid production in time of emergency.

It is not to be expected that any one type can be developed which will be satisfactory for all purposes. The trend of development, however, does appear to be in the direction of a limited number of types of chassis on each of which may be placed a series of different bodies or loads. For instance, a "light tank chassis" has been developed which is capable of carrying interchangeably, with slight modifications, either an armored tank house with its crew and armament, a seventy-five millimeter gun with armored shield, a cargo body for carrying ammunition or spare parts, anti-aircraft machine gun mounts, etc. This vehicle is of the track-laying type. It is capable of a cross-country speed of twenty miles per hour. Adopted types will probably include track-layers, heavy and light-wheeled chassis, tractors, trailers, and, in general a military analogue of nearly every distinct commercial type of vehicle.

Having accepted given limitations as to weight, etc., and adopted a general type of chassis, a host of questions present themselves for consideration when the matter of adjusting proposed loads to the chassis is taken up. A pound of weight allocated for one purpose cannot be used for another. Should armor be made heavier and load lighter or vice versa? Should the vehicle be self-propelled or should it be tractor-drawn, thus releasing the engine for other use when the gun is not moving and permitting the weight saved by omitting the engine to be given over to increasing the power of the gun or the armor protection of the crew? Must a certain amount of ammunition be carried with the piece or may it all go forward on separate vehicles? The answer to questions such as these hinge largely upon tactical considerations and are to be decided by a consideration of actual service tests conducted by those who are to use the material as well as in view of the mechanical considerations involved.



Courtesy *Army Ordnance*

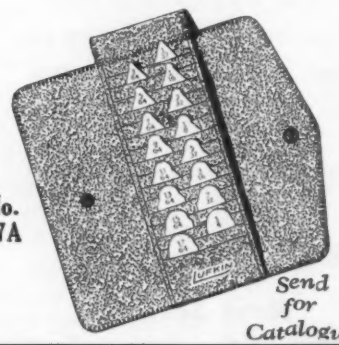
THE LIGHT TANK ON A COMMERCIAL TRUCK

The combination of a track-laying vehicle for cross-country going and a wheeled vehicle for rapid movement on hard surfaced roads is here secured by placing the tank on a truck when it is to be moved on wheels.

The advent of aircraft in the World War introduced a new factor in war. It became necessary to protect not only the troops on the firing line but the entire country for many miles in the rear of the firing line from attacks of hostile aircraft. (Indeed, the airship itself affords an excellent example of mechanized warfare.) It became necessary to improvise hurriedly from the most available means at hand anti-aircraft weapons to meet the new form of attack. Ground machine guns mounted on wagon wheels arranged to revolve about vertical axes serve to illustrate the sort of improvisation which took place. Such weapons were rather crudely mounted and generally of rather low power. The most essential element in their use — a range-finding system — was in the beginning entirely lacking and the development of such systems during the war, although vigorously prosecuted, did not reach anything like a satisfactory approach to a real solution.

The problem has now been solved by the introduction of mechanical-electrical means of fire control which reduce the human element to a mini-

(*Continued on page 238*)



LUFKIN

Improved Radius Gages

They embody outstanding features found in no other Radius Gage. Each gage is a separate unit, plainly marked with its radius size, and carrying both the internal and external forms.

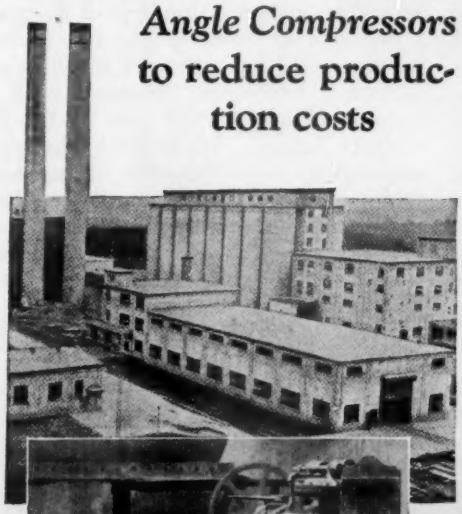
Set consists of 16 sizes from 1/32 to 17/64" radii by 64ths, all in attractive folder.
The cuts at upper right show but a few of their many uses.

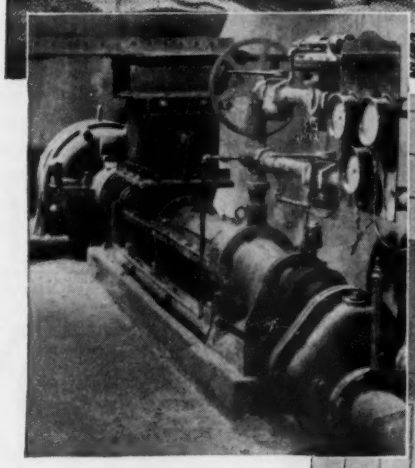
THE LUFKIN RULE CO. SAGINAW, MICHIGAN

106 LAFAYETTE STREET, NEW YORK CITY

Aerated Cement flows through Pipes, at this modern mill

How another leader of industry uses *Balanced Angle Compressors* to reduce production costs





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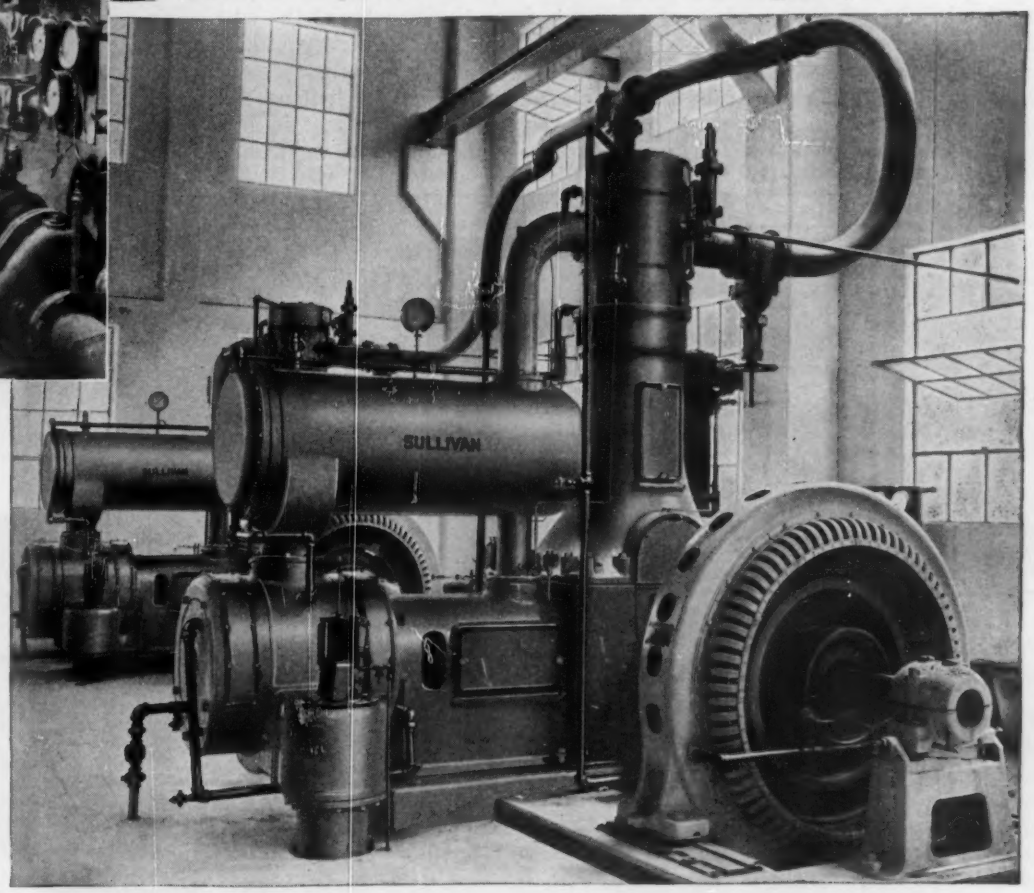

Two 1872-cu. ft. Balanced Angle Compound Compressors, direct connected to synchronous motors, in the plant of the Lawrence Portland Cement Company, Thomaston, Maine. They supply air for transporting cement, agitating clay and quarry drilling. View of the plant showing the 150,000-barrel silos; and the Fuller - Kinyon pumps.

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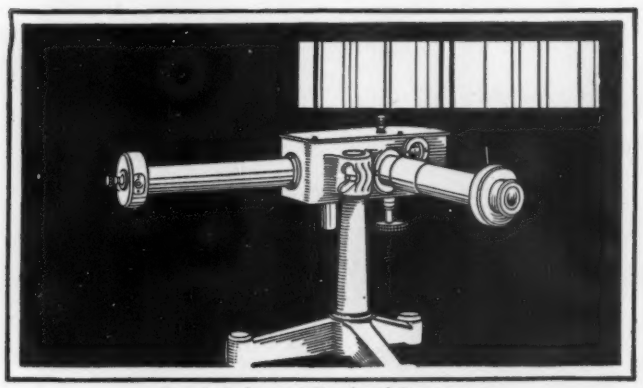
Military Mechanization

(*Continued from page 236*)

mum in the actual operation of the system. The heart of the new system is a data computer or director which automatically solves the problem and transmits the results to the gun. The outside appearance of the director is that of a big box mounted on a tripod. Two telescopes are provided. An operator looking through one and operating a handwheel, keeps the box turning around a vertical axis so that his telescope is always pointing toward the target. An operator looking through the other, turns a handwheel which moves his telescope in a vertical plane and keeps his cross hair on the target. Simultaneously, various dials and pointers on the outside of the box are kept set to indicate the other data which enter the problem — wind velocity, barometric height, etc. The solution requires, of course, the introduction of a measure of length and this is conveniently taken as the height of the target above the ground rather than its actual range. The range is rapidly changing, but the height of a bombing plane changes but slowly as it levels off to find its own target. Taking the data fed into it, the director solves the given problem continuously and sends the result to the gun in the form of an index setting so that the gun crew merely have the duty of so elevating and traversing the gun that the pointers on the gun are kept at all times opposite the corresponding indices set by the director. Three data must be transmitted to the gun — a direction, an elevation and a fuze setting so that the projectile will burst at the proper point. There is now no "dead time" as far as the first two of these data are concerned. The gun is fired on data which is current at the moment of firing. In the case of the fuze setting, there is a very short "dead time" in the time involved in removing the round of ammunition from the fuze setter, inserting it in the gun and firing the round — a matter of perhaps less than two seconds.

This system of range finding for anti-aircraft guns has been still further increased in the case of certain pieces by the use of what is known as a "torque amplifier." The use of this device does away entirely with the men setting the data from the director at the gun. The gun is kept automatically and continuously set at the proper direction and elevation for firing without human agency other than the two men who are at the director keeping their respective telescopes trained on the target.

It would not be difficult to continue indefinitely enumerating various directions in which the process of mechanization is taking place in connection with military technique. Enough has been said to indicate the tremendous importance to our country of keeping abreast of all scientific and technical progress. The progress of mechanization will necessarily proceed with a constantly accelerated pace for the indefinite future. What with the ever expanding developments of modern technology and the constantly improving means of communication of all sorts, it seems apparent that the predominant factor in future warfare will not be man power but the capacity of the belligerents to supply their armies sustenance and munitions, including in the latter term all the special material of every kind required for the prosecution of the war. The nation which is able most quickly to mobilize its scientific and technical resources, actual and potential, will have an advantage which may well be decisive. The fact that it is well prepared to so mobilize will be a factor of great weight on the proper side of the scales when they are just balancing on the issue of peace or war.



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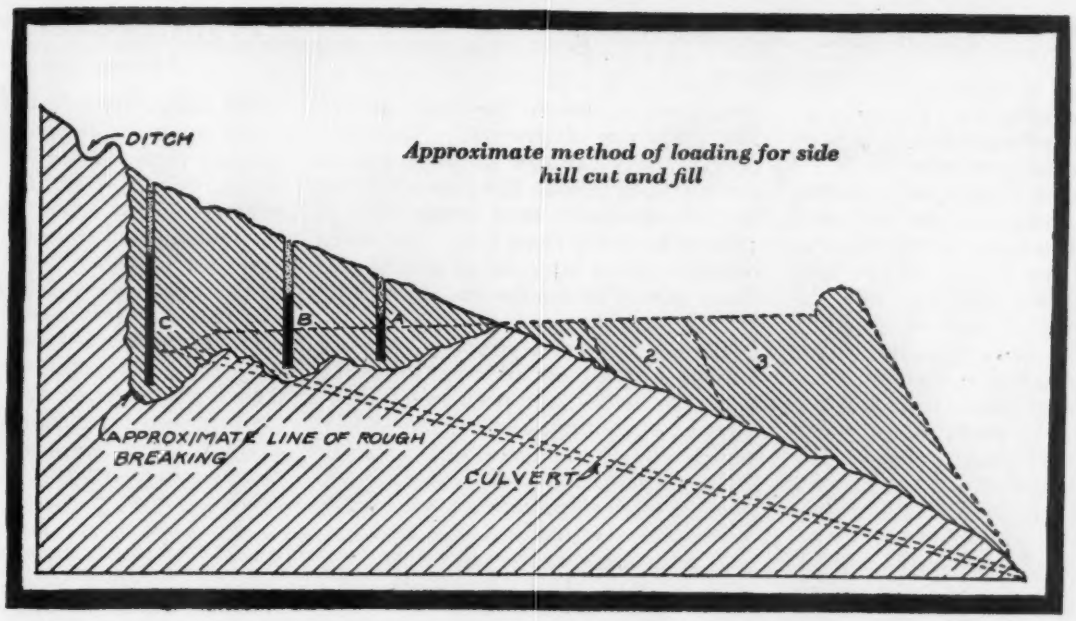

Approximate method of loading for side hill cut and fill

Road and Railroad Building

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Ships and Shipbuilding

(*Continued from page 226*)

or shell plating (Fig. 7). The cellular double bottom in warships is carried up the side to the protective deck.

The finished hull rests on a system of blocks. In order that the boat may be launched, it is necessary to transfer the weight of the hull from the keel blocks and shores (Fig. 11) to the launching ways. A pair of standing ways is built on blocks parallel to the center line of the hull and running the full length of the hull. On top of the standing ways is arranged a corresponding pair of sliding ways. Between the sliding ways and the ship a cradle of wood is built roughly conforming to the shape of the hull. Grease is inserted between the standing ways and the sliding ways so that the latter will slide over the former. The weight of the ship is then transferred gradually from the keel blocks to the cradle, and thus to the sliding ways, which are prevented from sliding by means of a piece of wood known as a dog shore. This can be quickly removed. Two or more dog shores are arranged on each of the two pairs of ways, and when all of these are released simultaneously, the ship, now supported entirely by the launching cradle, slides down the ways under the influence of gravity. American practice puts a trigger arrangement on the ways, to release the ship after the dog shores have been removed. It enters the water stern first. The stern becomes water born, lifts the ship and floats her, the cradle and launching gear floating away.

This is the most common practice among shipbuilders all over the world, although boats have been successfully launched bow first, and in some special cases, sideways. The ship may be fitted with her machinery after launching, although ships have been launched complete; one ship actually had fires in her furnaces at the launching.

J. H. Dodge, Jr. '31

A Flexible Coupling, intended for light duty on equipment requiring an inexpensive connecting unit of positive stability, has recently been announced. Essentially it consists of two die-cast flanges whose surfaces are true to bore, and these are connected by four set-screws, two in each flange, and screwed into nuts molded into a rubber center piece. This coupling will correct slight misalignment and absorb shocks.

Transmission of Sound

(*Continued from page 225*)

either side of this band. Boyer * has found a similar selective transmission through perforated plates and has also found that the frequency at which selective transmission occurs, shifts as the number and size of the holes in the plate are changed.

There is a similar selectivity in sound absorption. Most materials will absorb a greater amount of sound energy over some particular frequency band than at frequencies outside this band. Selective absorption usually takes place at high frequencies, whereas selective transmission usually takes place at relatively low frequencies.

We have also noticed that the quality of the transmitted wave is in general different from that of the incident wave. In this case a complex tone is used as the source. Some of the frequencies in the incident tone are much more suppressed than others during transmission. Change in quality seems to vary with porosity. A very porous material like hair felt shows much less change in the transmitted wave form than will a less

(*Continued on page 242*)

*M. R. Boyer, Thesis 1929, "Transmission of Sound Through Perforated Plates."

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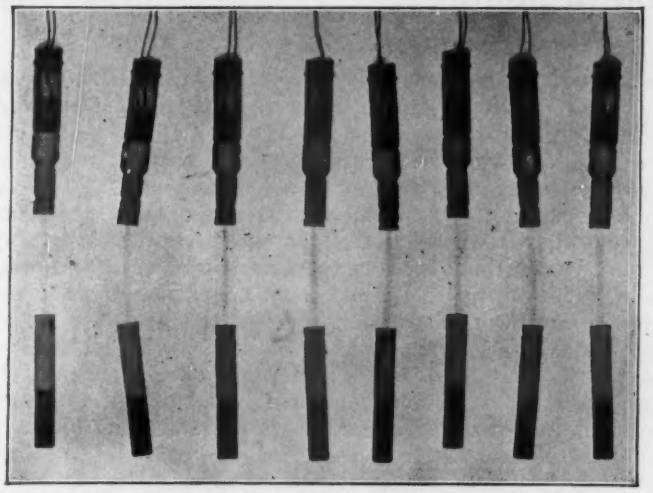

This illustrates the use of X-ray photography in testing for uniformity in Hercules delayelectric blasting caps. The X-ray reveals, from top to bottom of each delay electric blasting cap, the lead wires, firing head, delay fuse (in which only the powder train shows), and the blasting cap.

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Sectional view, Fig. 106, Jenkins Standard Bronze Globe Valve, screwed.

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VALVES
Since 1864

The Transmission of Sound

(*Continued from page 240*)

porous material such as wood. No satisfactory explanation for these selective effects has been proposed as yet. They are probably due to a molecular condition within the structure of the transmitting or absorbing material.

It is apparent that sound will travel through a wall in two distinct ways: first, as an air wave through the pores of the material; second, by setting the wall as a whole into vibration. The first can be controlled by decreasing the porosity of the wall structure. This is sometimes helped by building a double wall with a highly absorbing material as an interlining.

Quite often elaborate schemes are proposed for soundproofing a wall, without any thought concerning aerial paths through which a sound may travel. Doors, windows and ventilation systems often provide paths through which sound may be transmitted with little, if any, diminution in intensity. Doors and windows should be completely closed, for the sound entering through cracks may be intense relative to that transmitted through the wall itself. Soundproof doors have received considerable attention and there are several commercial products now available which are effective. Windows, particularly double windows, have not received so much attention. This is a problem which we hope to investigate during the coming year. Ventilating systems are often a source of trouble. Sound travels as easily through ventilation ducts as it does through speaking tubes. Bends and elbows are quite ineffective in reducing sound transmission. The air stream in the duct is also of little account since the velocity of air flow is small compared to the velocity of sound. In the usual type of ventilation system, the ducts for individual rooms branch from a common main which leads directly from the blower chamber. This is the type most easily installed and is usually the cheapest. It is, however, the worst type as far as sound transmission is concerned. Figure 7 is an illustration. Noise originating in the blower room A will pass directly to rooms B, C, D, E, etc. Moreover noise originating in any one room will have ready access to all the other rooms. A better arrangement, as illustrated in Figure 8, provides each room with an independent duct from the blower room. Noise originating in B, for example, must pass through the blower room A, before it can get to C, etc. Conditions can be greatly helped by treating the blower room and lining the ducts with some highly absorbing material. In case a ventilation system proves troublesome after it has been installed, sometimes the trouble can be overcome by the use of a simple baffle plate inserted in the duct. More pronounced cases may require the insertion of a baffle box in the duct. Such a box is illustrated in Figure 6. It is usually made of wood W, lined with absorbing material A.

Sound transmission is not a simple matter. The amount of sound transmitted can be calculated only for a very limited number of materials and then only when the material is homogeneous.

This article has dealt only with air to air waves; that is, waves which are incident in air and which emerge in air after passing through another medium. Sounds which originate in the structure of the building and which are carried through the various members of that structure, form another problem which cannot be discussed here.

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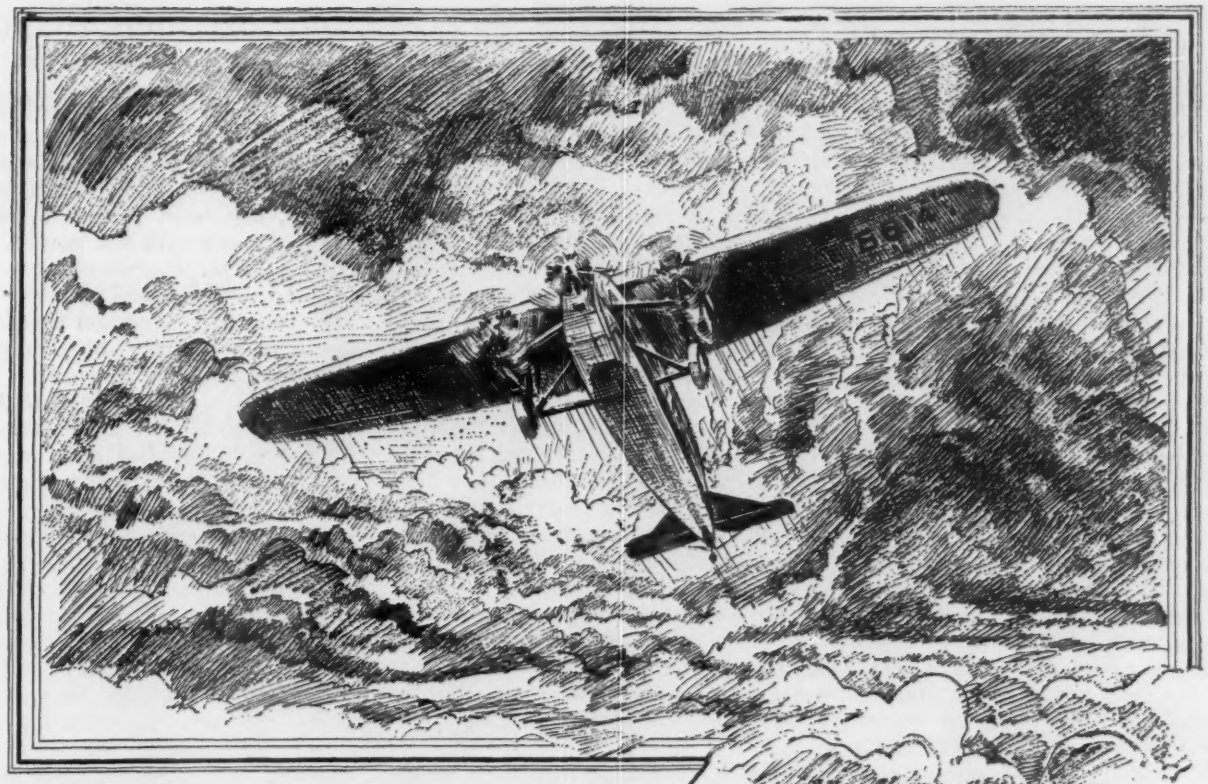

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30 East 42nd Street UCC New York, N. Y.

Modernism in Architecture

(*Continued from page 223*)

Ornament will be used to define, making indispensable organs of the architectural ensemble more slender, or lighter, heavier or larger, accenting them directly in the sense of their function.

Ornament used for any other purpose is an instrument of ugliness. It hides the structure of the edifice. The Italian Renaissance and all the Architecture of Europe since this period has sunk through disregard of this essential principle.

To answer the always insatiable needs of our civilization one wonders if the daring of our modern builders, which is great, would have as a limit only the more and more amazing enduring qualities of the new materials.

One wonders, too, if above the clamour of an entire working world we are to see raised in the sky, darkened by the mechanical flying insects, only temples of trade or of finance.

Will the setting sun light with its last rays only the gilded summits of the modern "Zigguras," similar to the one Babylon erected toward the stars and which at sunset flashed such a light that the plundering tribes were scared away.

The world becoming smaller and smaller, the relations between races tighter, customs being more standardized, architecture perhaps will have the same universal expression.

The machine which is essentially architecture, because all its elements are subordinated to the principal function, is already universal for it is or could be the same in all countries.

However this universal and uniform style is established, it will probably be interpreted differently under the influence of the intelligence and imagination of the constructors through local conditions, climate, structure, as man himself still remains almost unchanged with all his qualities or weakness.

Let man everywhere try to make his Domain something like a beehive, but never succeed in doing so. For man would be identical to the bee, an amazing monster of which the automatism inspires a sort of horror.

The 3,730 lb. Armatures of the eight motors used in the Cascade Tunnel locomotives are mounted on roller bearings. This is believed to be the largest roller-bearing installation of the kind yet made.

Departmental Notes

(*Continued from page 232*)

for a tour of duty at the Institute, and is in charge of the Coast Artillery unit.

The R. O. T. C. band, which was started two years ago with a student leader, has been placed upon a permanent basis with the employment of Mr. Eric H. F. Svensson, a retired regular army band leader, as instructor. Mr. Svensson was leader of the 55th Artillery band during its active service in France.

The changes instituted in the uniform have proved most satisfactory. The Freshman Battalion now compares favorably with any organization, in their roll collar, modified overseas cap, leather leggings and leather belts.

In coöperation with the Department of Mechanical Engineering, arrangements have been made with the Watertown Arsenal to have a number of seniors who are members of the Ordnance Unit, Advanced R. O. T. C., do their required thesis work at that place. The Arsenal is at all times conducting metallurgical research and investigations of various kinds in its finely equipped testing laboratory. All this work is being done with its practical applications to ordnance problems chiefly in mind.

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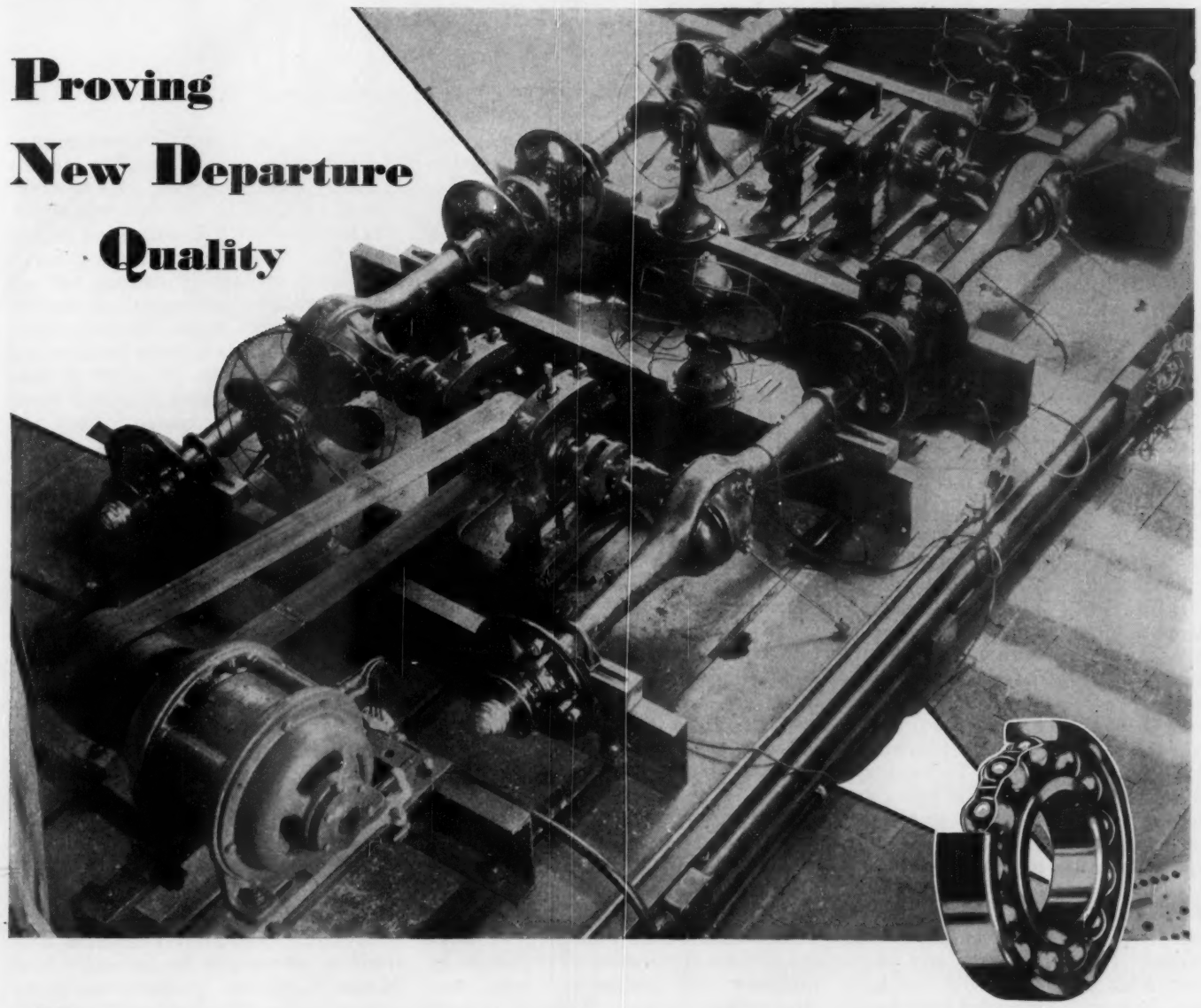

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The New Departure Mfg. Company, Main Offices and Works, Bristol, Connecticut; Detroit, Chicago, San Francisco and London.

NEW DEPARTURE

BALL BEARINGS

1278

Cultural Training for Engineers

(*Continued from page 219*)

of the schools of technology will itself undergo considerable modification, alike from the results of added experience, from larger means, and from the infusion of a wiser and more generous spirit. Doubtless more of economic, historical, and philosophical studies will be introduced to supplement, by their liberalizing tendencies, the work of the sciences in making their pupils exact and strong."

It can do no harm to remind ourselves at this point that culture is not merely a matter of book learning. Culture, in the broad sense of general education, as President Rogers used it, should include besides the acquisition of facts in fields relatively unrelated to one's chosen work, self-discipline, freedom from bigotry in any form, and, perhaps most of all, the ability to think for one's self. These cultural qualities may be inspired by what we read, may result from a desire to emulate individuals whom we admire, or may develop from a consciousness of our own lacks. From whatever source they spring they lead us to recognize another cultural influence that certainly exists at Technology, as it exists wherever men of parts are gathered together. I refer to the influence upon us as students of those able, distinguished men whose example and accomplishments, whose character and personality, are an inspiration to all who meet them. Such men were Presidents Rogers, Walker and Maclaurin; such men are with us here today. It is not alone what they teach us; it is rather what they are that stamps them forever in our minds as personifications of that culture which we seek. In this way we find that human quality which is essential to all true culture.

The many lecturers who come to Technology in the course of a four-year period, either as visitors from other countries or as typical of the best that our own land produces, provide either as individuals or in the subject matter of their lectures much that is of the greatest cultural value. They cannot fail to stimulate in our minds an interest in some one of the many activities, creative or otherwise, with which we may not be acquainted.

The Library at Technology is a mine of cultural resources in which we delve all too seldom. Books, as I have said, may not suffice to bring us culture, but they may well show us the way, tempt us to try some unknown path, and thus lead us to an understanding of and desire for knowledge of other subjects, not only because such knowledge may be useful to us but because in itself it is of engrossing interest.

Such possibilities outside of our chosen field lead to the formation of those invaluable avocations that may well become the resource of our later years when physical limitations prevent the continuance of the work that has hitherto engrossed all our energies. So strongly is the need for this compensating outlet realized by some men that they group together for no other purpose than to encourage expression outside of their habitual activities. Such a group in New York is called the Digressionists, and there you will find doctors, lawyers, bankers, architects, and doubtless engineers; but each is known to his fellows by what he can accomplish outside of his professional field. Similarly we have exhibitions of painting or sculpture by business and professional men, and thus culture comes. What an infinite joy there is in the discovery of these unexpected powers, and what a safety valve they form for minds, bodies and nerves, overtaxed by the ever increasing complications and demands of our present existence.

When we turn to those cultural opportunities that a Technology student may enjoy in common with any other dweller in the Metropolitan District we become aware of the many reasons why Boston is justly regarded as an education or cultural centre.

Perhaps its historical background and inheritance are of primary significance in this connection. Its association not only with the first settlers in this land but with those active beginnings that brought our present government into existence, cannot fail of cultural value to a student no matter where he comes from. Giving added significance to this historic background is the existence on all sides of fine examples of the homes in which these our ancestors were reared. They are in themselves evidence of a culture which we may well emulate. They have handed down to us methods of self-government, education, and independence of thought that are the very foundation of our social structure.

Correspondingly Boston has gathered about itself notable expressions of the arts — painting, sculpture, music, drama, archaeology — each and all in museums, in private collections, in public monuments, have many a notable expression. To further emphasize and enhance the value of these tangible evidences of culture, there occur throughout the academic year such a series of lectures on these and related subjects as may well embarrass the newcomer by the wealth of opportunities that lie before him from which he may take his choice.

Boston's Symphony Orchestra is in itself a monument to an individual, Major Higginson, who believed in the cultural value of music, and thus made it possible for us here in Boston to enjoy the best music in the land. Major Higginson throughout his life personified the very best that culture plus character can produce. Few of us may achieve what he accomplished for the community in which he lived, but each of us will be better equipped to follow his example if we make a determined effort to profit from the truly exceptional cultural opportunities with which we are surrounded.

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Write for Bulletin No. 81B

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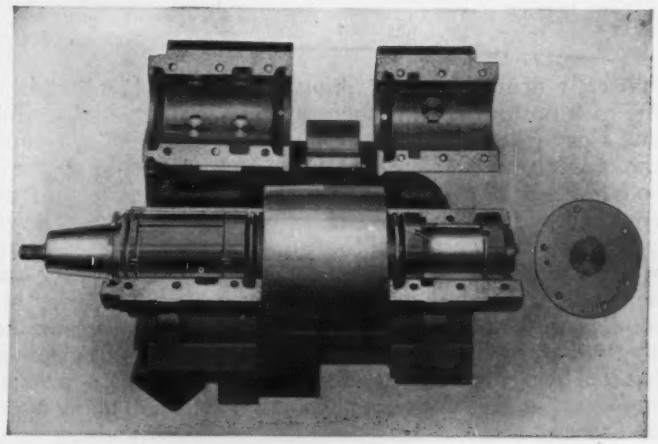
Bailey Meters at Western Electric Co., Kearney, N. J.



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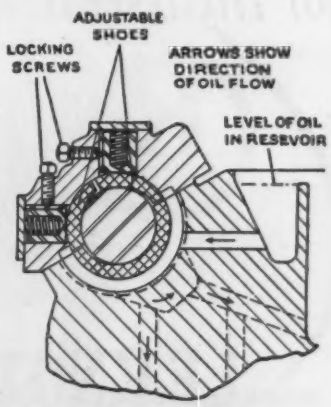
This feature is only one of the many reasons for the success of these machines wherever they are installed. An interesting booklet describing them will be sent at your request.



BROWN & SHARPE
BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

The Lake Champlain Bridge

(*Continued from page 222*)

matically opened upon striking either the rock bottom or the concrete previously deposited. Above the mud line the water was pumped out from the cofferdam and the remainder of the concrete laid in the open air.

To resist the pressure of the mud and water outside the cofferdam, which, on account of the greater weight of the mud, would not be entirely balanced by the water within, the cofferdam was braced by strong steel frames placed in the cofferdam in the form of a nest as soon as some of the mud was excavated. These were then lowered and put in place one by one as the remainder of the mud was excavated. These frames were ultimately buried in the concrete, the cofferdam being made so large that the concrete containing the frames was outside the area of concrete required to support the bridge structure.

So far as is known, the construction of bridge piers by single wall cofferdams of this type had never before been used to a depth so great as that at the Lake Champlain bridge where the bedrock is in places 100 feet below the surface of the water.

Another feature of the bridge worthy of attention is the provision of unusually high double curbs of concrete to prevent automobiles from falling over the side of the bridge, which the ordinary curb from 6 to even 10 or 12 inches in height does not always succeed in doing. The fact that the surface of the bridge floor at its highest point is something like 100 feet above the lake surface made it imperative that unusual precaution should be taken to prevent accidents from vehicles going over the side of the bridge, particularly as the bridge for much of its length is a deck structure without trusses or arches above the floor. In addition to the high curbs, a fencing which consists of steel wire mesh, secured at the top and bottom by strong wire cables connected to steel railing posts or to the trusses where they rise above the floor in the center span, is of itself probably sufficiently strong and elastic to hold back any car striking it. Those responsible for the bridge believe, however, that no cars will ever ride the curb.

The roadway surface is of concrete forming a part of the main floor slab but laid in such a way that if damaged by traffic it can be replaced without injuring the main concrete slab, the strength of which is a vital part of the strength of the bridge. This is accomplished by introducing a layer of wide mesh burlap in the concrete during the process of laying, thus serving to establish a line of cleavage such that the concrete above it can be readily removed without injury to the main portion of the slab itself.

The bridge is lighted by electric street lights, has electric navigation lights and is equipped so that an aeronautical beacon can be installed at an elevation of approximately 135 feet above the lake level if air navigation interests desire it.

The bridge is fully insured against damage from any insurable cause, including fire, tornadoes, floods, collapse.

The writer's firm, Fay, Spofford & Thorndike, designed and supervised the construction of the bridge, estimated the amount and receipts from traffic, and prepared the financial program for the information of the bankers who took the bond issue of $1,000,000. The foundations were built by Merritt Chapman and Scott of New York, and the superstructure by the American Bridge Company.

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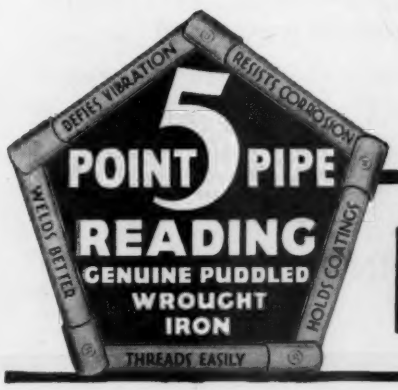

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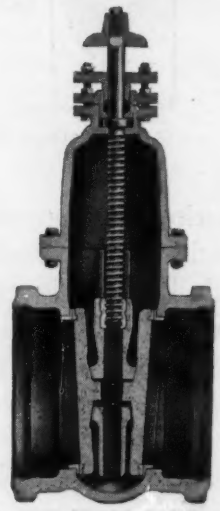

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